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IN THIS ISSUE

THE National Health Survey afforded an unusual opportunity to study simple but important aspects of housing adequacy in relation to sickness and accidents among large numbers of urban families in different sections of the country. Some of the outstanding situations are described by Rollo H. Britten, J. E. Brown, and Isidore Altman, of the United States Public Health Service, in their article: "Certain Characteristics of Urban Housing and Their Relation to Illness and Accidents: Summary of Findings of the National Health Survey." The report is divided into five sections concerning: degree of crowding, toilet facilities, illness and crowding, digestive diseases and toilet facilities, and home accidents in relation to rental or value of the home. The authors interpret their findings with care, for it is realized that poor housing is often accompanied by a train of other factors known or believed to be prejudicial to health. The article will be welcomed by the increasing number of students and officials interested in problems of housing and public health.

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In a paper, "Economics of the Family Relative to Number of Children," Dr. Frank Lorimer and Mr. Herbert Roback of The American University, present results of their investigation of the effect of added numbers of children in the family on proportion of income spent for specific items, such as food, housing, transportation, medical care, recreation, etc. The data were derived in large part from the Federal Study of Consumer Purchases. The analysis was made separately for three types of communities and within each type of community the families were subdivided into four groups with respect to number of children under sixteen years of age. The results are of basic interest to students of home economics and afford a better understanding of the economic penalties of parenthood in modern society.

The application of medical and objective technique has contributed significantly to the progress of medical sciences. One of the more recently developed of such techniques is the electrostethograph, by means of which the sounds emanating from the human heart may be recorded graphically and permanently in the form of a tracing on a photographic film. In "Cardiometric Studies on Children, Number II" Drs. Bert R. Boone and Antonio Ciocco present a statistical analysis of measurements of the duration of the cardiac cycle and first and second sounds from the stethographic records of nearly 1,500 school children. The main objective of these cardiometric studies, conducted by the United States Public Health Service, is to arrive at a means of developing an objective "screening device" to select children who require special attention or care with respect to the heart and circulatory system.

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Rheumatic fever cannot at the present time be cured with serums or with medicines. Dr. John R. Paul in a discussion of "Factors in the Occurrence of Rheumatic Fever," in this issue of the Fund's *Quarterly,* recommends improvement of the environment for the rheumatic child as a measure of prevention. Since rheumatic fever is a familial infection efforts to improve the environment should, according to Dr. Paul, be considered from the point of view of the whole family. The geographical distribution of the disease, familial aspects of the disease, rheumatic fever as a city disease and a crowd disease are some of the factors in its occurrence discussed by Dr. Paul.

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Because rheumatic disease is a serious form of illness which tends to be chronic and which occurs fairly frequently in young children or in young adults, the problem of its control is a matter of importance to physicians and public health officials. The two conditions which seem to favor rheumatic disease are, as in tuberculosis, familial association with the disease and a generally low standard of living. However, its etiology is not definitely known and its infectivity has not been clearly established. The study "Familial Association and Aggregation in Rheumatic Disease," by Dr. R. L. Gauld and Dr. F. E. M. Read, gives the results of an epidemiological investigation to determine whether or not the attack rate among carefully observed familial associates of cases of rheumatic fever is characteristic of an infectious disease.

CERTAIN CHARACTERISTICS OF URBAN HOUSING AND THEIR RELATION TO ILLNESS AND ACCIDENTS: SUMMARY OF FINDINGS OF THE NATIONAL HEALTH SURVEY[1]

ROLLO H. BRITTEN, J. E. BROWN, AND ISIDORE ALTMAN

ALTHOUGH more complete reports on the subject are in preparation,[2] it seems appropriate at this time to summarize the results of the National Health Survey bearing on the adequacy of urban housing and on the relation of housing to illness and accidents. The presentation will be in the form of simple illustrative charts[3] and such discussion of them as is necessary for clarity.

The National Health Survey was conducted from November, 1935 to March, 1936 for the purpose of obtaining information on serious illness, accidents, impairments, and medical care received, in relation to social and economic factors. Manifestly, one of the most important of these factors is housing, and, accordingly, certain information on housing was obtained and has been related to the illness record. The survey was made within the city limits (1930) of eighty-three cities in eighteen States (and in a limited number of rural areas), the cities being chosen to be reasonably representa-

[1] From the Environmental Sanitation Section of the Division of Public Health Methods, National Institute of Health, United States Public Health Service. The survey, a house-to-house canvass, was executed with the aid of grants from the Works Progress Administration. The scope, method, and general definitions of the study have been described previously: Perrott, George St. J.; Tibbitts, Clark; and Britten, Rollo H.: The National Health Survey: Scope and Method of a Nation-wide Canvass of Sickness in Relation to its Social and Economic Setting. *Public Health Reports*, September 15, 1939, 54, No. 37. Reprint No. 2098.

[2] One detailed report has already been issued: Adequacy of Urban Housing in the United States as Measured by Degree of Crowding and Type of Sanitary Facilities. National Health Survey, Preliminary Reports, Sickness and Medical Care Series. Bulletin No. 5, Division of Public Health Methods, National Institute of Health, United States Public Health Service, Washington, 1938.

[3] This series of charts was presented at a meeting of the Committee on the Hygiene of Housing of the American Public Health Association, held in New York City, November 6-8, 1939.

tive of geographic area and size-of-city groups. In large cities (100,000 population and over) the sample of households to be canvassed was determined by a random selection of many small districts based on those used in the United States decennial census of 1930. In the smaller cities selected for study, the population was enumerated completely. The data in this report have been limited to urban areas and to households[4] (except where otherwise noted) with at least one person related (by blood, marriage, or adoption) to the head of the household. There were 631,429 such households[5] canvassed.

1. Degree of Crowding

Although crowding may be evaluated in several ways, it was necessary in the National Health Survey to employ a simple measure, and that chosen was the number of persons per room.[6] As this index was calculated separately for each household, it was possible to determine the percentage of households falling into specified degree-of-crowding groups. Admittedly the measure is one of dwelling crowding *per se* and does not *directly* take into account use-overcrowding and congestion in halls and streets. If such aspects had been included, the percentage of households showing crowding would have been greater. Also it is to be observed that there are many dwelling units which, although not congested, are deficient from other hygienic points of view, such as lack of adequate ventilation, absence of sunlight, insufficient natural or artificial

[4] The household in the Health Survey was a group of persons (or one person) living in a dwelling unit such as a house, apartment, rooming house, dormitory, nurses' home, or room or suite in a hotel. The household included all persons who resided (slept) in the abode. "Family," as used in reports of the National Health Survey, refers to the group of members of the household related to the head; the term is avoided in this article since unrelated members are included throughout.

[5] The total number of urban households canvassed was 703,092. Thus, 71,663 (10 per cent) were excluded by confining attention to those with at least one person related to the head. Those excluded were mostly single-person households, dormitories, and rooming houses in charge of individuals with no person related to them living in the household.

[6] The number of persons per room is the ratio of the total number of persons in the household to the total number of rooms in the dwelling unit or abode in which the household resided. Bathrooms were excluded and kitchens included in this calculation.

illumination, dilapidation, fire hazards, absence of proper sanitary facilities, etc.[7] The measure of crowding used is subject to certain other limitations. For one thing, it is not possible to judge precisely the relative significance of the crowding index for households unlike in size—to judge whether, for instance, the occupying of two rooms by four persons is of the same significance to well-being as the occupying of four rooms by eight persons. Also, even for households of the same size there will be dissimilarities in average room size and in age composition.

Three groups have been distinguished on the basis of the crowding index: (1) households[8] with more than one person per room, (2) those with more than one-and-a-half persons per room, (3) those with two or more persons per room. The cumulative form is used to make summation by the reader unnecessary. It is important to emphasize the fact that these three groups are employed with no intention of fixing an exact line of demarcation between crowded and uncrowded households. It is precisely because the relation is one of degree that three levels of congestion have been adhered to.

The percentages of all households falling into the three degrees-of-crowding groups were respectively: 17.6; 6.3; and 4.0.[9]

Since crowded households tend to be large households—a point discussed on page 95—the proportion of *persons* living under a specified degree of crowding will be much greater than the proportion of *households* showing that degree of crowding. In Figure

[7] A recent publication relating to housing needs from the point of view of health is: Basic Principles of Healthful Housing. Committee on the Hygiene of Housing, American Public Health Association, May, 1939 (second edition).

[8] Throughout the report (except where otherwise noted) the word *household* will be used to mean a household with at least one person related to the head. Households with eight or more members in which the number of persons exceeded the number of rooms by *one* are not included in any of these three groups, but only in the total (i.e., as one person or less per room).

[9] The corresponding percentages for all households (including those with no person related to the head) were: 16.1; 5.9; and 3.8. *See* paper cited in footnote 2. As stated (*see* footnote 5), most of the households with no person related to the head were single-person households. Clearly, a person living alone will have at least one room to himself; hence, the lower values.

1 these two sets of percentages are compared. The difference is patent. Whereas there were 17.6 per cent of ***households*** with more than one person per room, 25.9 per cent of *persons* were living in households with more than one person per room; a similar relation is shown for the more severe degrees of crowding.

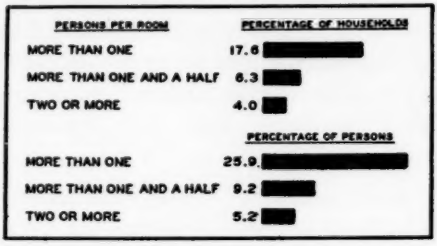


Fig. 1. Percentage of households with different degrees of crowding and percentage of persons therein. (Data for persons based on 0.5 per cent random sample of punched cards.)

In the bulletin previously referred to (*see* footnote 2) stress was placed on the wide variation in the character of the housing problem in different parts of the country, in cities of different sizes, in individual cities in the same geographic-area-and-size-of-city group, and in various groups of the population in any one city. It was stated that no generalizations based on averages for the whole area would suffice to describe the housing situation, and it was pointed out that in one city 40 per cent of the households had more than one person per room, while in another city less than 3 per cent showed this degree of crowding. Although in the present article data will not be presented for individual cities, the variable nature of the housing problem will still be manifest.

Contrary to popular impression, crowding is a problem of the small city as well as of the large. This fact is apparent from Table 1 giving the percentage of households with more than one-and-a-half persons per room.[10]

The above data also suggest differences by geographic area. These are shown graphically in Figure 2 (for white and colored households separately). The South shows the highest percentages for

[10] *See also* table 2 in bulletin cited in footnote 2.

Size of City (1930)	Area			
	Northeast[1] Per Cent	North Central Per Cent	West Per Cent	South Per Cent
500,000 and Over	4.6	5.8	4.2	—
100,000 to 500,000	4.4	5.8	3.4	12.1
25,000 to 100,000	2.3	5.4	4.1	13.9
Under 25,000	2.7	6.4	4.3	15.6

[1] The Health Survey States included in the four regions are: Northeast—Massachusetts, New Jersey, New York, Pennsylvania; North Central—Illinois, Michigan, Minnesota, Missouri, Ohio; West—California, Oregon, Utah, Washington; South—Alabama, Georgia, Louisiana, Texas, Virginia.

Table 1. Percentage of urban households in the Health Survey with more than one-and-a-half persons per room, by area and size of city.

both white and colored. For white, the lowest percentages are found in the West; for colored, in the Northeast.[11]

A marked contrast in the amount of crowding among white and colored households is indicated by the figure—the colored population is manifestly one of the focal points of the housing problem.

Under housing conditions existing at the present time, the size of the household is another primary factor in the amount of crowding. In the Health Survey, the proportion of households with more than one-and-a-half persons per room varied from 3 per cent for two-person households to nearly 50 per cent for eight-or-more person households. The curves by size of the household are given in Figure 3.[12] As suggested above, no data are available to

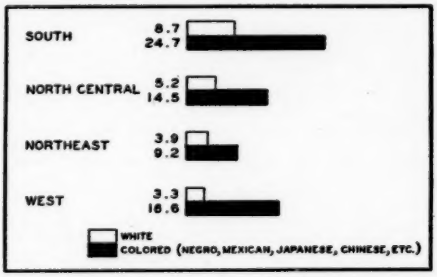


Fig. 2. Percentage of households with more than one-and-a-half persons per room by geographic region and color.

[11] Although "colored" in most sections of the country is essentially Negro, the percentage for colored in the West is largely determined by non-Negro groups. Mexican has been included with colored for the purpose of this report.

[12] Irregularities in the two lower curves shown in the figure are due to the nature of

(Continued on page 96)

determine at all precisely the relative significance of this index of crowding for families of different sizes.

That there is a high degree of association between crowding and economic status is generally recognized. The point received primary consideration in the bulletin cited above (*see* footnote 2), where the amount of crowding in each city surveyed was shown against annual family income and relief status. In this summary, it has seemed preferable to relate crowding directly to the amount of rent charged.[13] In later reports these comparisons will be made in more detail; but here, as a matter of simplification, and in view of the wide divergences in crowding in households of different sizes, a special group has been chosen—namely, five-person white households living in rented "multiple"[14] dwellings. For this special group, as shown in Figure 4, the percentage with more than one-and-a-half persons per room fell from 72.6 for households with rentals below $10 a month to 6.8 for house-

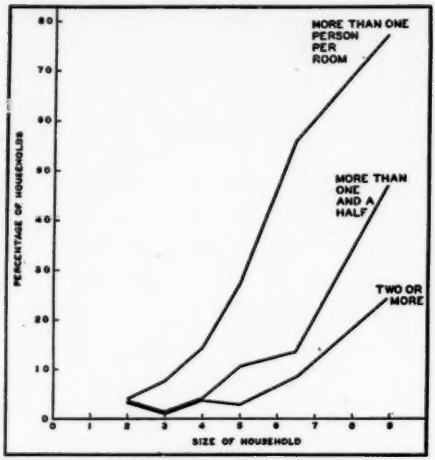


Fig. 3. Percentage of households with different degrees of crowding by size of household.

the index which is based on discrete values (the number of persons and the number of rooms in each dwelling unit). *See also* footnote 8.

For reasons of tabulation, persons unrelated to the head were disregarded in classifying households by size (in computing persons per room all persons in the household were counted; *see* footnote 6).

[13] For households renting their living quarters at the time of the visit a record was made of the monthly rental being charged (not necessarily paid) for such quarters at that time; for households owning their living quarters at such time, the record made was that of the family informant's estimate of the value of such quarters.

[14] A "multiple" dwelling in the Health Survey was one in which the individual dwelling units did not have separate entrances from the street.

holds with rentals of $30 a month or more. Similar relations existed for rented "single" dwellings, for households of other sizes, and for households living in owner-occupied dwellings (against value rather than against rental).

One additional point relative to crowding which deserves mention, even in a brief summary, is its variation with age. Since larger households, which tend to be more crowded, also tend to have younger persons in them, it is but natural that wide differences would be found in the proportion of persons of particular ages in the three degree-of-crowding groups. In Figure 5 these relations are illustrated separately for the white and the colored populations. The percentage in each of the three degree-of-crowding groups decreases

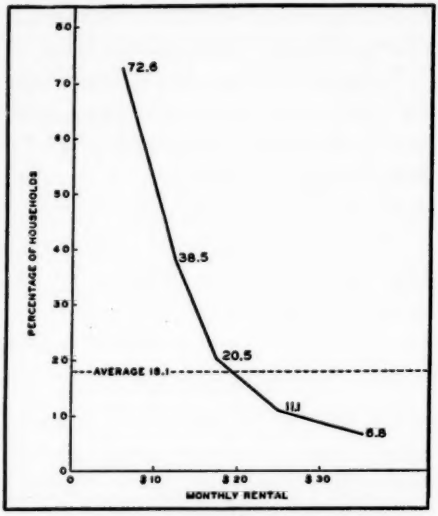


Fig. 4. Percentage of households with more than one-and-a-half persons per room by monthly rental. (Five-person white households in rented multiple dwellings.)

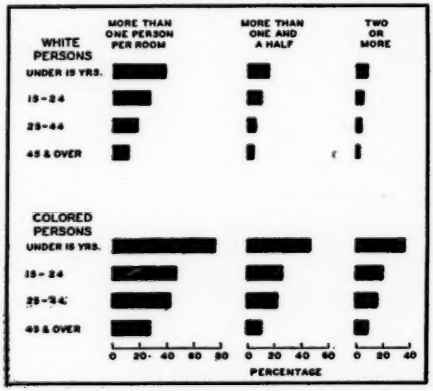


Fig. 5. Percentage of persons in households with different degrees of crowding by age and color. (Based on 0.5 per cent random sample of punched cards.)

markedly as age increases. Crowding is evidently much greater among children[35] than among adults.

To summarize the data on crowding, it may be stated: (1) that the problem of crowding (as measured by the index "persons per room") is present in the small as well as in the large city, (2) that it varies with geographic area, (3) that it is much greater for the colored population, (4) that it increases with size of the household, (5) that it is greatest at low rental levels, and (6) that the percentage of persons living under crowded conditions decreases as age increases.

II. Toilet Facilities

With the widespread use of the water-carriage system of sewerage, a flush-type toilet inside the dwelling unit and not shared with other households would seem to be—at least in urban areas—one essential of good housing.[36] In the Health Survey, 11.4 per cent of urban households did not meet this standard.[37] The type of toilet facilities available to this group, with the percentage of all households using each type of facility, is shown in Table 2.

Table 2. Percentage of households in the Health Survey having specified type of toilet facilities.

Type of Toilet	Percentage of Households
Not Shared With Other Households	
Flush, Outside	2.9
Privy	4.1
Shared With Other Households	
Flush	
Inside	3.1
Outside	0.9
Privy	0.5
Total Without "Private Inside Flush Toilets"	11.4

There was a greater relative frequency of substandard toilet facilities in smaller cities. The quantitative relations were shown in tables

[35] It should be recalled (footnote 6) that the degree-of-crowding index is based on the total number of persons in each household (regardless of age).

[36] *See* article cited in footnote 7.

[37] This percentage is less than that given for all households in the article cited in footnote 2, for which the figure was 13.0 per cent. The exclusion of households without at least one person related to the head affects particularly the percentage with inside flush toilets shared with other households.

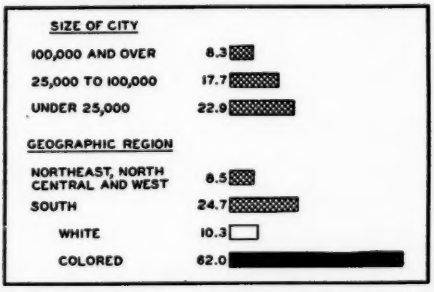
3-6 of the previously cited bulletin (*see* footnote 2); here a few illustrations must suffice. For households with two or more related persons, the percentages which either lacked inside flush toilets, or shared them with other households by size of city are shown in Table 3. These percentages are shown graphically in Figure 6, which also gives corresponding percentages for the South in comparison with other parts of the country, and separately for the white and the colored households in the South. Even for white households alone, the percentage was greater in the South than in other parts of the country. It was six times as great for the colored as for the white households in the South.

Table 3. Percentage of urban households in the Health Survey lacking private inside flush toilets, by size of city.

Size of City	Percentage of Households
100,000 and Over	8.3
25,000 to 100,000	17.7
Under 25,000	22.9

Averages given in this figure fail to depict the wide variation from city to city in the percentage of households not meeting the above standard (i.e., without private inside flush toilets). Such variations are so great as to make a consideration of the data for individual cities almost a necessity. Hence, reference is again made to the previous article (*see* footnote 2), in which the percentages were so shown. The number of cities with specified percentage of households without private inside flush toilets,[18] for different city sizes are shown in Table 4.

Fig. 6. Percentage of households *without* private inside flush toilets by size of city, geographic region, and color.



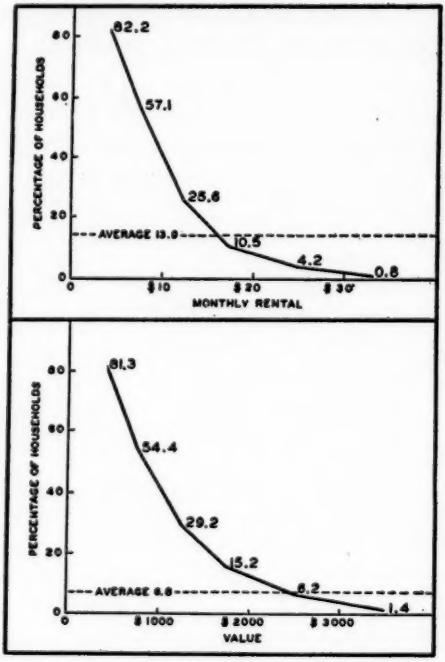
[18] All households are used for this comparison, rather than those with at least one person related to the head.

Size of City	Number of Cities			
	Under 10 Per Cent	10-19 Per Cent	20-29 Per Cent	30 Per Cent and More
100,000 and Over	18	7	5	1
25,000 to 100,000	4	2	2	2
Under 25,000	12	7	6	17

Table 4. Number of cities in the Health Survey classified by size and percentage of households lacking private inside flush toilets.

The wide range exhibited in this table is closely associated with variations in the average income level of different cities and with the proportion of households which were colored. Furthermore, although in the high income groups practically all households, wherever the city and whatever its size, had inside flush toilets which were not shared with other households, in the case of any particular low-income group there was a wide variation from city to city in the percentage not meeting the standard.

Fig. 7. Percentage of households *without* private inside flush toilets by rental or value.



In Figure 7 is brought out the close relation between rental (or value, for owner-occupied dwellings) and the percentage which lacked inside flush toilets or shared them with other

households. At monthly rentals of over $30, the percentage is nominal; on the other hand, at low rentals it is very great. It may be stated that similar relations hold for large cities as well as for small[19] and in each geographic area.

A slightly different point of view may be taken. It may be asked, what rental (or value) is required to furnish various population groups with facilities of the type under consideration? Accordingly, in Figure 8, the proportion is expressed as the percentage of households *with* inside flush toilets that were not shared with other households. For the purpose of this summary, the white and colored in the South have been contrasted with the rest of the country, the comparison being limited to certain low-rental (or value) groups in cities of from 25,000 to 100,000 population. (It is to be noted that direct comparison with the lower part of Figure 6 therefore cannot be made.)

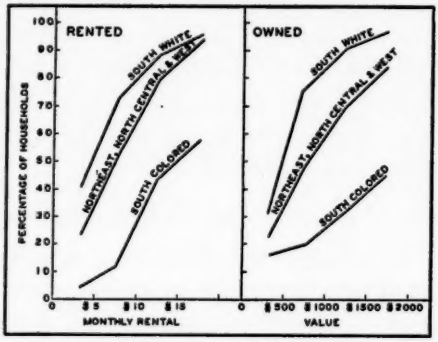


Fig. 8. Percentage of households with private inside flush toilets by geographic region, color, and rental or value (cities of 25,000 to 100,000).

Figure 8 shows, to choose an example, that with rentals of from $10 to $15 a month, about 90 per cent of white families in the South in the specified size group met the standard set, whereas 80 per cent of families in the rest of the country met it. However, the figure indicates that of the colored households in the South with this rental, only 45 per cent had inside flush toilets which were not shared with other households.

[19] In large cities the deficiency tends to consist in the communal use of inside flush toilets; in small cities, in the absence of such facilities.

To summarize the data on toilet facilities—in terms of the percentage of households which either did not have inside flush toilets or shared them with other households—it may be stated: (1) that the smaller cities showed much larger percentages, (2) that the South fared worse than the rest of the country, (3) that colored households in the South showed the highest percentages, (4) that there were wide variations from city to city apart from the question of geographic area or size, and (5) that there was a close relation with rental (or value).

III. Illness and Crowding

The existence of excessive rates of sickness and mortality in the slums or overcrowded districts of cities is an accepted fact, but the extent to which poor housing *per se* is responsible for these differences is very difficult to ascertain because of the interaction of many economic and sociological factors.[20] An intensive analysis of the data of the Health Survey bearing on this question has been undertaken; but, pending the completion of such studies, it seems opportune in this summary to give the illness rates obtained in households characterized by various degrees of crowding, even though at this time it is not possible to unravel all the causative factors. Comparisons will also be made for households at different economic levels.

In this section (Illness and Crowding) the persons-per-room index takes on a different significance than when used to measure the extent of crowding. Because of the close association between congestion and other aspects of deficient housing, the index is one of

[20] *See:* Britten, Rollo H.: The Relation Between Housing and Health. *Public Health Reports,* November 2, 1934, 49, No. 44. Reprint 1656.

DallaValle, J. M.: Some Factors Which Affect the Relationship Between Housing and Health. *Public Health Reports,* July 23, 1937, 52, No. 30. Reprint 1840.

Winslow, C.-E. A.: Housing as a Public Health Problem. *American Journal of Public Health,* January, 1937, 27, No. 1.

Britten, Rollo H.: Housing and Health. *American Journal of Public Health,* August, 1938, 28, No. 8.

Leukhardt, John C.: The Influence of Housing on Health. *The Interne,* October, 1939, v, No. 10.

general housing quality. This fact has weaknesses and virtues. Although it will not be possible to separate the factor of crowding *per se* from the other aspects of poor housing, it will be possible to use a simple index to stand for more than the index seems to mean at first glance. The results are not to be interpreted as expressing merely the relation between crowding and illness. However, it must also be realized that the index is a crude measure of economic status, and that families sometimes live in crowded conditions because disease has reduced their income to the point where they cannot pay rent for adequate quarters.

It has been found convenient to establish three groups of households by degree of crowding and to assign the letters *A, B,* and *C* to such groups. The table below defines the groups and shows the percentage of persons in each. These figures (as well as the data on illness in this section) relate to the white population only[21] and to households which included both the household head and his wife.[22]

	Per Cent
A. One Person or *Less* Per Room	74.9
B. More Than One Person Per Room, But *Not More* Than One-and-a-Half	16.7
C. More Than One-and-a-Half Persons Per Room	8.3

With respect to the type of illness rates employed, it should be stated that in the National Health Survey information was obtained for a twelve-month period immediately preceding the visit. Since it was realized that minor illnesses, especially of a non-

[21] Differences in the incidence of disease among white and colored persons and questions of the relative efficiency of reporting among white and colored persons have made it desirable, for the purpose of this brief summary, to exclude discussion of illness rates for colored persons.

[22] It was necessary, for reasons of tabulation, to confine attention in this section to households which included both the household head and his wife. The population in such households was 1,841,000. With the further exclusion of persons concerning whom certain information was not known (family income, education of wife of the head, persons per room, or age) the population base becomes 1,769,993.

disabling type, would tend to be forgotten, analysis[23] was limited to illnesses which had caused disability for seven consecutive days or longer during this twelve-month period.[24] Disability was defined to mean inability to work, attend school, care for home, or carry on other usual pursuits by reason of disease, accident, or physical or mental impairment.[25]

The rate to be discussed first is the percentage of persons having an illness disabling for a week or more during the twelve months immediately preceding the visit.[26] Because of differences in the age composition of households in the three groups (relatively more children and fewer middle-aged and old persons in the more crowded households), it has been found desirable to determine what such rates would be if a standard age composition were assumed.[27] Adjustment of this character permits consideration of the relation between illness and housing, with the effect of one influencing factor (age) approximately removed.

The unadjusted and adjusted rates (i.e., the percentages of persons with an illness disabling for a week or longer), for the three degree-of-crowding groups are shown in Table 5. The ratio of the adjusted rate for group *C* to that for group *A* is 1.20.[28]

[23] Certain other information (e.g., illnesses from which a person was disabled on the day of the visit, chronic diseases whether disabling or not) was also obtained, but will not be discussed since not presented in this report.

[24] Including confinements, hospital cases, and fatal cases, without limitation as to the duration of disability.

[25] *See* article cited in footnote to title of this paper for specific illness definitions employed in the Health Survey. A summary of the illness data has also been published: Britten, Rollo H.; Collins, Selwyn D.; and Fitzgerald, James S.: The National Health Survey: Some General Findings as to Disease, Accidents, and Impairments in Urban Areas. *Public Health Reports,* March 15, 1940, 55, No. 11.

[26] This rate is less than that of the frequency of illnesses disabling for a week or longer, since in the former case not more than one illness for any person enters into the rate. (There were 1.14 illnesses per person with an illness of the type specified.)

[27] The customary method was used, adjusting each crowding group to the age distribution of all such groups combined; that is, within any specified group (*A, B, C*) the rate for each of four age groups was multiplied by the total number of persons in that age group (*A, B,* and *C,* combined), the products were summed, and the sum was divided by the total number of persons.

[28] For two or more persons per room the percentage was 18.9 (adjusted to the standard age composition)—the ratio of this percentage to that for group *A* being 1.28.

Degree of Crowding	Per Cent	
	Unadjusted for Age	Adjusted for Age
A One Person or Less Per Room	14.6	14.8
B More Than One Person Per Room, But Not More Than One-and-a-Half	15.8	15.7
C More Than One-and-a-Half Persons Per Room	17.2	17.8

Table 5. Percentage of urban white persons in the Health Survey having illness disabling one week or longer, according to degree of crowding.

As suggested in the beginning of this discussion, this excess is, in part at least, associated with differences in economic status. Figure 9 indicates, however, that some excess was present in the relief group, taken by itself, and in the nonrelief group with annual family incomes under $1,000. The ratio of the rate for degree-of-crowding group *C* to that for group *A* in these two instances was 1.09 and 1.12, respectively. Although these differences are not very great, the large population involved makes them significant.

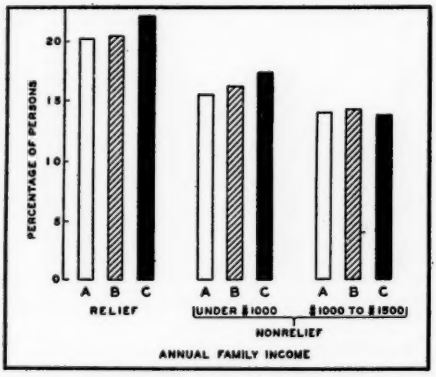


Fig. 9. Percentage of white persons with an illness disabling for a week or longer during one year by degree of crowding and income. (Adjusted to standard age composition.)

In Figure 9 the effect of age was eliminated in the manner described; but it is also of interest to show the extent of the excess of the illness rate among persons of different ages. This comparison is made in Figure 10 for a few broad age groups, representing children, youths, productive and middle

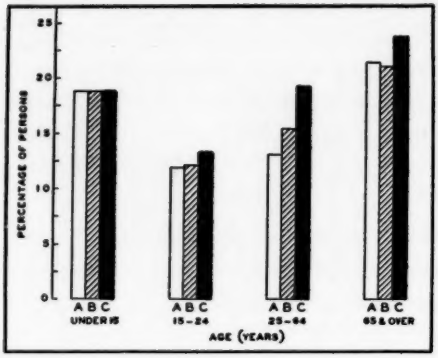


Fig. 10. Percentage of white persons with an illness disabling for a week or longer during one year by degree of crowding and age. (Age group under 15 adjusted to standard size of household.)

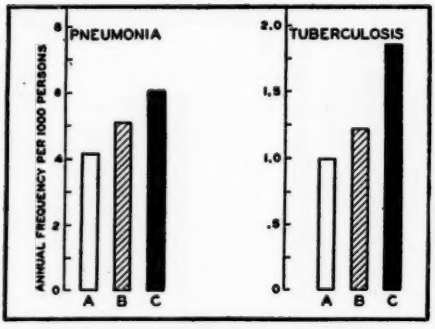


Fig. 11. Annual frequency of pneumonia and tuberculosis (illnesses disabling for a week or longer) in different crowding groups, among white persons. (Adjusted to standard age composition.)

ages, and old age. An excess is found in each of these groups (except that of children[20]); it is greatest in the productive period of life.

With these relations in mind, one's interest turns to specific diagnoses, especially those which might be expected to reflect more sensitively the effect of poor housing. Further study is being made of the relation by diagnosis, but it is possible to present the comparison for a few diseases[80] now. In Figure 11 is shown the annual frequency of pneumonia and of tuberculosis.[81] As in the case of Figure 9, adjustment has been made to a standard age composition. There is noted a marked increase in the

[20] A slight decrease was present in the basic rates, which was due to differences in family size. Adjustment was therefore made to a standard size of family.

[80] Illnesses disabling for a week or longer during the twelve months immediately preceding the visit, including fatal illnesses and hospital cases of any duration of disability. Sole and primary diagnoses.

[81] Persons in institutions for the care of physical or mental diseases were not directly

(Continued on page 107)

rate for each of these diseases as the degree of crowding increases. It may be stated that for pneumonia there were also sharp increases in the rates with increased crowding within the relief group and within the next higher income group (nonrelief, under $1,000).

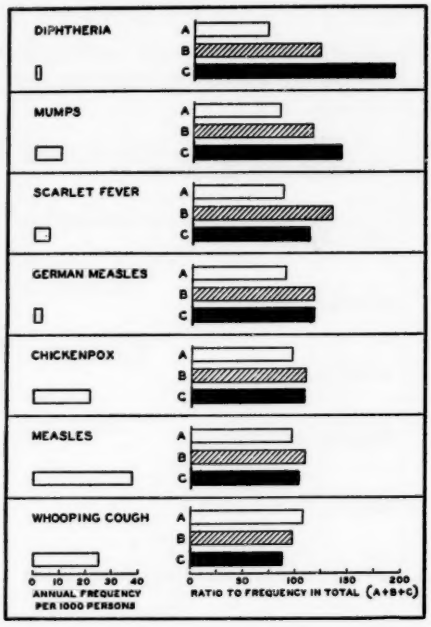


Fig. 12. Frequency of common communicable diseases of childhood and ratio of frequency in specific degree-of-crowding groups to that in total. (White children under 5 years of age.)

Figures 12 and 13 present data for the common communicable diseases of childhood. The former gives for each of these diseases (a) the rates per 1,000 children under 5 years of age—that is, during infancy and preschool ages—and (b) the ratio in any specific degree-of-crowding group (*A, B, C*) to the total rate. Several diseases show relatively higher rates in the more crowded groups (especially diphtheria and mumps); but a point of particular interest is brought out in Figure 13, giving for each of these diseases and for each degree-of-crowding group, the ratio of the rate for children under 5 years of age to that for children aged 5 to 9 years. Without exception, these ratios increase from group *A* to group *C*,

enumerated in the Health Survey, but the family was asked to report with regard to any such persons who had formerly lived in the household. The record obtained was incomplete; hence, the cases of tuberculosis on which the rates in Figure 11 are based are largely those still in the home.

indicating a younger age incidence of these diseases under the conditions associated with poor housing. It is generally recognized that a younger age incidence means a greater risk of serious complications and of mortality. As in the other comparisons, it is not possible to determine exactly what factors in the poor housing environment are responsible for differences found, but in this instance the suggestion is made that the number of children in the household may be an important, perhaps the primary, factor in the association. It has already been shown (Figure 5) that crowding is more pronounced among children.

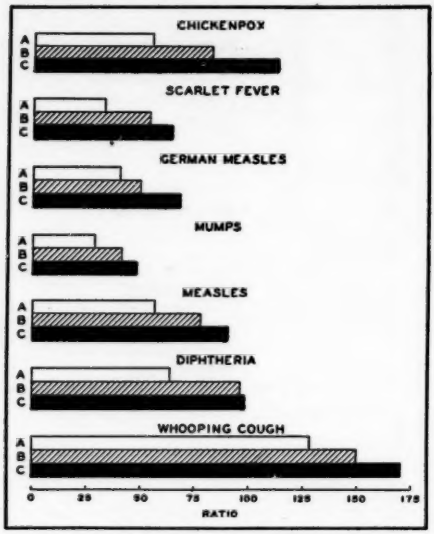


Fig. 13. Ratio of (1) frequency of common communicable diseases of childhood in age group under 5 to (2) that in age group 5-9 for each degree-of-crowding group.

To summarize the data on illness and crowding, it may be stated: (1) that the frequency of illnesses disabling for a week or longer is greater in crowded households, (2) that this is true, in less degree, for the relief group and for the nonrelief group with annual family incomes under $1,000, (3) that there is a marked increase in the incidence of pneumonia and tuberculosis with increase in crowding, and (4) that the common communicable diseases of childhood show an earlier age incidence in crowded households.

IV. Digestive Diseases and Toilet Facilities

In Figure 14 is illustrated another approach to the problem of re-

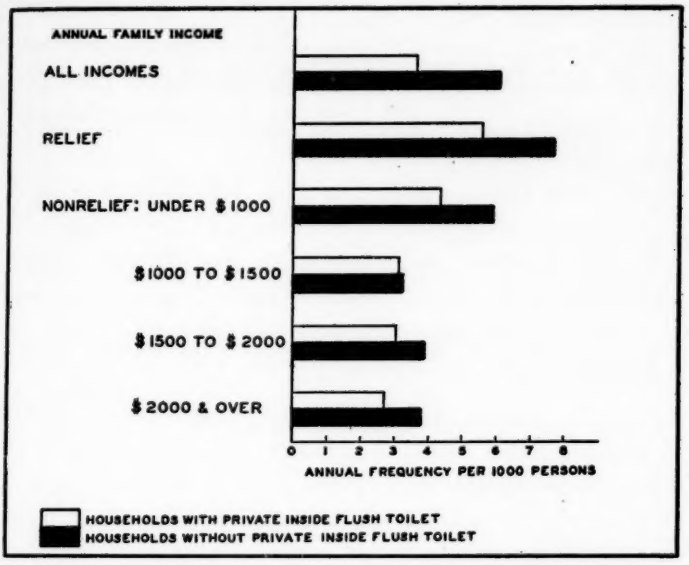


Fig. 14. Frequency among white persons of certain digestive diseases disabling for a week or longer during one year in relation to presence of sanitary facilities, by annual family income. (Indigestion and other stomach ailments; diarrhea, enteritis, colitis; typhoid and paratyphoid fevers.)

lating illness and housing. A group of digestive diseases,[32] the incidence of which might be thought to be associated with the presence or absence of various types of toilet facilities, have been selected and their frequency correlated with the index used in the section dealing with these facilities. In other words, the rate per 1,000 persons living in households[33] with private inside flush toilets has been compared with that for persons in households not meeting this standard. The illnesses are limited to those causing disability for a week or more[34] during the twelve months immediately preceding

[32] Indigestion and other stomach ailments; diarrhea, enteritis, colitis; typhoid and paratyphoid fever. Sole, primary, and contributory diagnoses.

[33] White households in which there was at least one person related to the head, known income (population 2,076,641).

[34] Including fatal illnesses and hospital cases of any duration of disability.

Area and Toilet Facilities	Rate of Digestive Diseases		
	Cities 100,000 and Over	Cities 25,000 to 100,000	Cities Under 25,000
Northeast, North Central, and West			
With Private Inside Flush Toilet	3.3	3.9	4.1
Without Private Inside Flush Toilet	4.8	7.3	6.8
South			
With Private Inside Flush Toilet	4.0	5.0	5.3
Without Private Inside Flush Toilet	5.1	8.0	8.2

Table 6. Frequency of digestive diseases (disabling one week or longer) per 1,000 urban white persons in Health Survey households with and without private inside flush toilets, by geographic area and size of city.

the visit. The rates in the two groups were 3.6 and 6.1 respectively—an excess of 70 per cent in the group without private inside flush toilets. In the interpretation of this excess, several points must be borne in mind. First, in households not meeting this standard there will probably be concomitant deficiencies (especially, lack of screening and poor facilities for refrigeration of food) which may have an effect on the illness rate from this group of digestive diseases. As in the case of the crowding index employed in the preceding section, we are confronted with an expression which tends to measure poor housing as a whole. In the second place, the excess may be due, in part at least, to the lower economic level of households which do not meet the standard set as to toilet facilities. However, the chart (Figure 14) shows that the excess is marked in each income group. Because an earlier comparison showed a marked change in the percentage having private inside flush toilets with size of city and geographic area, a third point is whether such differences can account for the relation shown. That they do not is shown by Table 6, giving the frequency per 1,000 persons of these digestive diseases (defined as in Figure 14) by geographic area and size of city, for white persons in households with and without private inside flush toilets.

To summarize the data on digestive diseases and toilet facilities, it may be said: that the rate for persons in households without inside flush toilets, not shared by other households, showed a marked excess over the rate for persons in households having such facilities.

v. Home Accidents and Rental (or Value)

Accidents in the home are frequently the result of specific hazards associated with dilapidation and other factors involved in poor housing. Hence, it is of interest to consider the correlations found in the Health Survey, in which a record was obtained for serious accidents (disabling for a week or more during the twelve months immediately preceding the visit). Accidents were classified by the enumerator as home, public, or occupational, and whether due to an automobile or not.[85] For the present purpose home accidents only will be considered, for which the rate was 4.6 per 1,000 persons.[86]

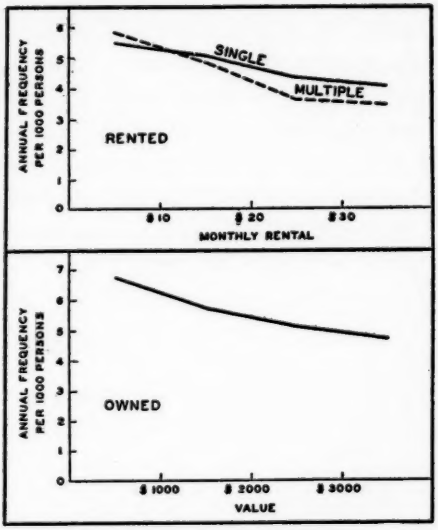


Fig. 15. Frequency of accidents in the home disabling for a week or longer, by rental or value.

[85] *See:* The National Health Survey, 1935-36, Accidents as a Cause of Disability. Preliminary Reports, The National Health Survey, Sickness and Medical Care Series, Bulletin No. 3. Division of Public Health Methods, National Institute of Health, United States Public Health Service, Washington, 1938.

[86] Cases disabling for a week or longer, including fatal cases and hospital cases of any duration of disability. Sole, primary, and contributory diagnoses.

The entire surveyed population is used in the comparisons in this section, except for the exclusion of unknown rental (or value) and unknown age (population 2,415,000).

No information bearing directly on the condition of the houses surveyed was obtained; hence, it is again necessary to establish an index for purposes of comparison. In this instance, the most logical basis seemed to be the rent charged for the dwelling unit (or the value, if owner-occupied). (*See* footnote 13.) Since earlier comparisons (Figure 4) have shown that the lower the rental, the more crowded the dwelling unit, it is clear that the index must be regarded as measuring more than appears on the surface. That is, while rent (or value) fails to be an adequate measure of accident hazards in the home, it tends to measure, as do the crowding and toilet facility indexes, the whole poor housing environment. From one point of view, however, we are on surer ground than in the illness rate comparisons, since as a general rule current accidents

Means of Injury[1]	Rate per 1,000 Persons
Falls	2.97
Burns	0.38
Cutting and Piercing Instruments	0.58
Miscellaneous	0.67

[1] *Falls* relates to falls of persons and includes fractures and sprains unspecified as to means of injury. *Burns* comprises burns of any type (except those from electric currents). *Cutting and piercing instruments* includes infected wounds unspecified as to means of injury. The *miscellaneous* group is made up largely of accidents caused by machinery, animals, firearms, etc., and of poisonings (gas, food, plants, etc.). Homicides and suicides (including attempts) are excluded.

Table 7. Frequency of home accidents (disabling one week or longer) per 1,000 persons in the Health Survey group, by means of injury.

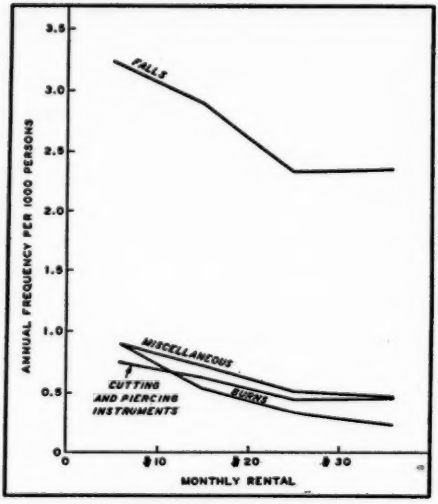


Fig. 16. Frequency of home accidents disabling for a week or longer, by means of injury and rental. (Households in rented multiple dwellings.)

will not of themselves have driven the family into homes for which lower rents are charged. These are points to be kept in mind in evaluating the comparisons.

In Figure 15 are plotted curves for the frequency of home accidents disabling for a week or longer. For rented dwellings a separation is made as to single and multiple. (*See* footnote 14). All three curves show an inverse correlation with rental (or value).[87]

Home accidents were classified in the Health Survey by means of injury, as shown in Table 7. A future report will present these data in more complete form; here it must suffice to give one additional chart, by way of example. Figure 16 indicates that, for rented multiple dwellings, the rates for accidents due to each of these means of injury decrease with increasing rental. Burns show the greatest relative decrease.

To summarize the data on home accidents, it may be said: (I) that the frequency of home accidents decreased as the rental (or value) went up, and (2) that this tendency was true of accidents due to various means of injury (such as falls, burns, etc.).

Summary

In this report have been given the general results of the National Health Survey bearing on (I) degree of crowding, (II) toilet facilities, (III) illness and crowding, (IV) digestive diseases and toilet facilities, and (V) home accidents and rental (or value). The findings have been summarized at the end of each section.

[87] The reason for the higher rate for owned than for rented is not clear. The excess is confined to falls (3.4 for owned, 2.8 for rented single, 2.6 for rented multiple).

ECONOMICS OF THE FAMILY RELATIVE TO NUMBER OF CHILDREN

FRANK LORIMER AND HERBERT ROBACK[1]

INTRODUCTION

LARGE families are now economically handicapped, in the United States and in many other countries, in three respects.[2] (1) Larger families tend at the present time to be concentrated at the lower income levels. This is true as regards regional variations, and as regards variations among economic groups in the same community or region.[3] The situation in the urban population of the United States in 1935-1936, as regards distribution of families comprising husband and wife and varying numbers of children under 16 years of age, by economic classes, is shown in Figure 1. For example, 17.4 per cent of the families with only one or two children received incomes of $2,000 or more per year, but only 10 per cent of

[1] From the Graduate School, American University.

Based on data from the Study of Consumer Purchases, with supplementary references. The Study of Consumer Purchases presents data from a nation-wide survey conducted by the Bureau of Labor Statistics of the United States Department of Labor and the Bureau of Home Economics of the United States Department of Agriculture, with the cooperation of the Works Progress Administration, the National Resources Committee, and the Central Statistical Board. This paper treats one phase of consumption pattern in relation to family types. The reader is referred to the published reports for full discussion of methods and findings in the survey.

The paper was prepared in the Seminar on Population Studies, Graduate School, American University, the data drawn from the following sources: Family Expenditure in Chicago, 1935-36. Bureau of Labor Statistics, Bulletin No. 642, Vol. 2; Family Income and Expenditure in Nine Cities of the East Central Region, 1935-36. Bureau of Labor Statistics, Bulletin No. 644; Family Income and Expenditure, Middle Atlantic and North Central Region, Farm Series. Bureau of Home Economics, United States Department of Agriculture (To be published). The present writers are solely responsible for the treatment and interpretations presented in this paper.

[2] In this statement and in the following treatment, size of family is considered only as it is affected by number of children. We are not concerned here with size of family as affected by groupings of "primary" and "secondary" families or other variations in numbers of adults, nor with "broken" or "single-person families."

[3] National Resources Committee: THE PROBLEMS OF A CHANGING POPULATION, Chaps. 4 and 5; Karpinos, Bernard D. and Kiser, Clyde V.: The Differential Fertility and Potential Rates of Growth of Various Income and Educational Classes of Urban Populations in the United States. The Milbank Memorial Fund *Quarterly*, October, 1939, xvii, No. 4, pp. 367-391.

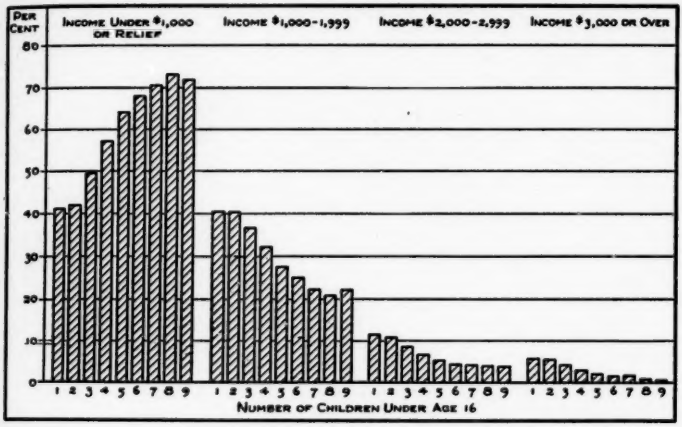


Fig. 1. Per cent of urban families with husband and wife and specified number of children in each of four economic classes. Public Health Survey Sample, 1935-36. Data from the "Economic Status of Urban Families and Children" by I. S. Falk and Barkev S. Sanders, *Social Security Bulletin*, May, 1939, 2, No. 5, pp. 25-34.

the families with four children, and only 5 per cent of the families with eight children. (2) The possibility of increased family income through gainful work by wives is sharply reduced by the presence of a child in the family, and somewhat further reduced as the number of children increases.[4] (3) The consumption level of the family, in given income classes, is lowered by the necessity of dividing the available economic resources among a larger number of members.

The last statement is axiomatic; but it has been impossible, until recently, to know how this general lowering of consumption levels with increased size of family affects different items in the family budget. The present paper is concerned with an investigation of this topic, using data provided by the Federal Study of Consumer Purchases, 1935-1936, limiting the comparisons to the four family

[4] This topic is developed in a collateral paper by Edward Hollander. *See also* United States Department of Agriculture: Family Income and Expenditures, Plains and Mountain Division, Part One, Family Income. Miscellaneous Publication 345, p. 58; Pacific Region, Part One, Family Income. Miscellaneous Publication 339, p. 76.

types which include husband and wife but no other persons over 16 years of age, for native white, nonrelief families in the East North Central area. The data relate to the families in the "controlled sample" for two of the four community groups in this area studied by the Bureau of Labor Statistics, namely (1) Chicago and (2) three middle-sized cities (New Castle, Pa.; Muncie, Ind.; Springfield, Ill.; which for convenience sake, will be called "middle cities" in this paper), and to a sample of farm families in Pennsylvania and Ohio, studied by the Bureau of Home Economics. The family types used in this analysis following the family type classification[8] used in the study of Consumer Purchases are as follows:

I. Husband, wife, no children.
II. Husband, wife, one child under age 16.
III. Husband, wife, two children under age 16.
VI. Husband, wife, three or four children under age 16.

Methods

Throughout the investigation, comparison is made between families of different types at given income levels. The results, therefore, are intended to show differences in consumption patterns and in savings among families with varying numbers of children under age 16 years, on the assumption that all types of families are distributed in the same way among income classes. Actually, as already stated, we know that this assumption is fictitious; but it is used in order to show how expenditures and savings are influenced by the size of family when the influence of differences in distribution by income is held constant.

Standardized proportional expenditures for various consumption categories are presented for each family type. These values are derived from the percentages of total money expenditure (or percentage of total value of living, i.e., money income plus imputed

[8] Not all of the family type classifications used in the original study have been used in this analysis. The classification numbers used in the Consumer Purchases Study have been retained.

value of economic goods and services obtained without direct money expense, in the case of farm families) spent for each consumption category by families of a given type in each income class. The percentage expenditures for particular categories by families of the same type in different income classes are then averaged, using as weights for each area the number of families in each income class in a "standard population." The "standard population" used here represents the distribution by income of families of all types in the random ("eligible") sample in each area. The values obtained therefore represent average proportional expenditures for different consumption categories by families of each type, weighted according to the income distribution of all nonrelief, native white families in each area. A similar procedure is followed in the analysis of savings.

Several supplementary methods were also used, but the results, which in general merely confirm those obtained by the method described above, are not reported in detail in this paper. One supplementary method (using sums of ranks) and the results obtained are presented in an appendix. Another procedure was as follows: the expenditure for each consumption category by families of a given type was expressed as a ratio to the expenditure for that category by families of all types, combined, separately for each income class. The average of such ratios for each family type, with respect to each expenditure category, was then computed, using as weights the number of schedules obtained from families of each type in each income class. In this procedure the number of cases sampled in each cell is taken into account, without regard to the distribution of families by income in the community—whereas the reverse holds for the standardized proportional expenditures. The family type variations shown by these "averages of ratios" were in general the same as those indicated by the "standardized proportional expenditures" reported below. In discussing expenditures for food, reference will be made to a related analysis by another investigator.

General Results

The proportion of family income spent for food rises as size of family increases from husband-and-wife, to husband-wife-and-one-child, to husband-wife-and-two-children, to husband-wife-and-three-or-four-children. This pattern appears consistently in each of the three areas. In spite of this rise in proportional expenditure, the nutritional level, as measured by actual expenditure for food per meal per adult-equivalent, falls in inverse proportion. It is therefore apparent that food requirements exert an urgent pressure on the budget of American families, which is intensified as the size of family increases.

The increased expenditure for food, at given income levels, by families with children is offset by curtailment of expenses on many different items. Except for decreases in gifts and taxes, which offset about one-third or one-fourth of the increases for food, this curtailment is not consistently evidenced for any particular group of expenditures, but appears at various points, notably household operation, furnishings and equipment, and transportation.

Apparently the increased housing needs of families with children are just about balanced by increased financial strain, so that proportional expenditure for housing remains fairly constant. In some areas, but not all, clothing expenditure rises with increasing size of family. Expenditure for formal education rises consistently, but such expenditure is a negligible item in the total budget of most American families with no children aged 16 or over.

Summary results are presented in Table 1 and Figure 2. Supplementary information on particular items will be reviewed topically.

The preceding paragraphs relate to distribution of expenditures, or value of family living (including imputed value of food, housing, and household operation, in the case of farm families). Number of children also affects the relation of total expenditure to income. When the data for both urban series are standardized, families

without children, or with only one child under age 16, show on the average small but substantial net savings during the period covered by the study (3 per cent to 5 per cent of money income, as the standardized mean of the proportional net savings in different income classes). On the other hand, in both urban series, families with two or more children had, on the average, a very narrow margin between income and expenditure (less than 1 per cent of money income). In other words, among such families, the deficits of those who were unable to make both ends of the family budget meet just about cancelled the savings of those who kept expenses below current income. Among farm families the savings were

Table 1. Standardized percentage distribution of money expenditures (urban) or value of family living (farm) by consumption categories for specified family types.

Expenditure Classes	Chicago				Middle Cities				Pennsylvania-Ohio Farms			
	Family Type				Family Type				Family Type			
	I	II	III	VI	I	II	III	VI	I	II	III	VI
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Food[1]	31.1	34.2	36.6	38.6	30.2	31.6	33.7	36.4	35.8	38.3	39.4	42.8
Housing[2]	26.4	26.0	24.4	25.6	24.9	24.2	23.0	23.9	23.0	20.5	19.6	18.7
Household Operation[3]	4.6	4.7	4.3	4.3	4.7	4.2	4.0	3.9	11.2	10.3	9.4	10.1
Furnishings and Equipment	3.2	2.6	3.0	2.4	4.9	5.0	4.2	3.6	3.8	3.4	2.8	2.8
Clothing	9.0	8.9	9.0	8.8	8.5	9.2	9.2	9.4	5.7	7.0	8.4	8.4
Transportation	8.7	7.1	7.4	5.4	9.3	8.6	9.8	7.4	8.7	8.9	9.7	7.0
Gifts and Taxes	3.7	2.6	2.3	2.0	4.4	2.9	2.9	2.4	4.3	2.4	2.4	2.4
Medical Care	4.4	5.3	4.3	4.5	4.2	4.9	3.9	4.2	3.2	3.9	4.0	3.7
Recreation and Amusements	2.8	2.7	2.9	2.4	2.8	3.2	3.0	2.6	1.1	1.8	1.3	1.2
Reading	1.2	1.1	1.1	1.0	1.2	1.2	1.2	1.1	.7	.7	.6	.5
Miscellaneous	4.9	4.8	4.7	5.0	4.9	5.0	5.0	5.1	2.5	2.8	2.4	2.4
Education	0.2	0.3	0.5	0.9	0.0	0.3	0.6	0.9	0.0	0.2	0.2	0.3
Personal Care	2.1	2.1	2.0	2.0	2.0	2.3	2.2	2.1	0.9	1.2	1.1	1.1
Tobacco and Other	2.6	2.4	2.2	2.1	2.9	2.4	2.2	2.1	1.6	1.4	1.1	1.0

[1] Including imputed values for farm families only.
[2] Money expenditure for housing, plus fuel, light, refrigeration for urban families; money plus imputed value of housing for farm families.
[3] Including imputed values and including fuel, light, refrigeration for farm families only.

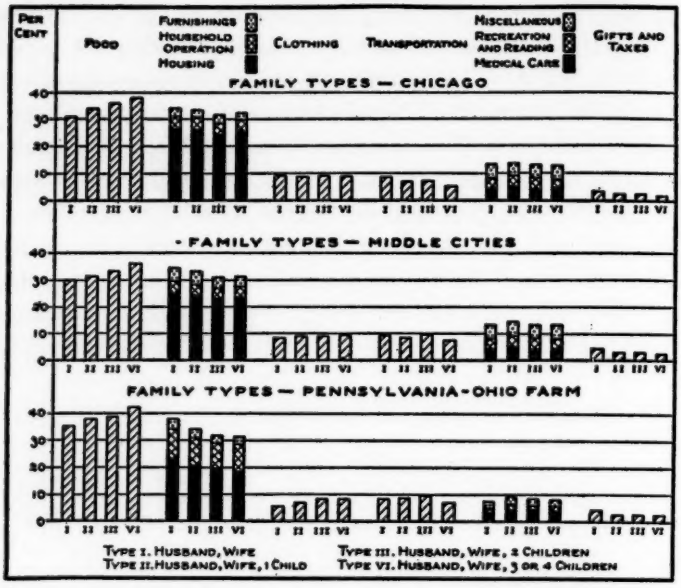


Fig. 2. Per cent of total money expenditure (Chicago, Middle Cities) or per cent of total value of family living (Pa.-Ohio Farm) in specified consumption categories by area and by family type. Standardized mean proportions. Data from Consumer Purchases Study.

larger, but the proportion declines as size of family increases. The results of this analysis, using data for a highly variable item from small samples, must be accepted with some caution. However, in so far as the results are accepted, they point to the extremely precarious financial situation of urban families with children, under present conditions. This is also evidenced by the large proportion of such families which have been compelled to apply for public relief.[8]

[8] Families that had received relief during the previous year were not included in the "eligible sample" of the Consumer Purchases Study. Falk and Sanders found that among urban families relief was reported by 13.3 per cent of the families without children, 16.8 per cent of the families with one child, 20.1 per cent of the families with two children, 35.9 per cent of the families with four children, and 56.7 per cent of the families with eight children.

Food

Food is the major item in the expense account of most American families. For example, in Chicago, it accounts for over 40 per cent of the total money expenditure of families with incomes below $1,000, 33 per cent of the total money expenditure of families with incomes of $2,000-$2,249, 30 per cent of the total money expenditure of families with incomes of $3,500-$3,999, and 21 per cent of the total money expenditures of families with incomes of $7,500-$9,999. Because of the importance, for the present investigation, of the data on food costs, a description of the terms and methods used in the preparation of these data is quoted at length.[7]

Food

Included here were all family expenses for food, together with expenditure for such items as ice cream, candy, soft drinks, beer, and alcoholic beverages. Cod-liver and haliver oil were also considered food.

Nonfood articles which may be bought in grocery stores, such as cleaning supplies, matches, soap, tobacco, and food for pets were excluded from this category.

Food At Home. A distinction was made between food purchased to be prepared at home and food purchased and eaten away from home. In the former category was included expense for any food prepared at home but eaten away from home, such as home-prepared lunches for work, school, or picnics. Expense for articles such as coffee, milk, or other food, bought at work or school to supplement the home-prepared lunches was classified with expense for food away from home.

Food purchased to be prepared in a vacation home occupied by the family was classified as expense for food at home.

The amount spent for food served to boarders was derived through use of the average expense per meal per equivalent adult (explained below), and was deducted from total expense for food at home, so that the figures shown in table 2, column 6, and table 3 of the Tabular Summary represent net family expense.

[7] United States Bureau of Labor Statistics: Family Expenditures in Chicago 1935-36, pp. 226-228. The same terms and definitions are used by all the agencies cooperating in the Study of Consumer Purchases.

Food Away From Home. Included here was expense for meals at work and at school (except for food carried from home), including board at school, meals while traveling or on vacation (except for food prepared in a vacation home), meals purchased on a business trip for which there was no reimbursement by an employer, other meals eaten out, and ice cream and candy, soft drinks and alcoholic beverages consumed away from home.

Expense for food away from home necessarily included in many cases some expense for service and entertainment as well as food costs proper.

Average Money Expenditure Per Meal Per Equivalent Adult. In recognition of the variations in quantity, and thus in expense, of food consumption among persons of different ages, the following scale of relative requirements for various persons served from the family food supply was adopted:[7] (Footnote 7, p. 228: This scale of food relatives was developed from data secured from the Bureau of Home Economics of the Department of Agriculture, which furnished information on standard food allowances, based on actual expense records, differentiated by age, sex, and activity.)

Age of Person	*Relative Food Expense*
20 Years of Age and Over	1.0
13 to 19 Years	1.1
6 to 12 Years	.9
Under 6 Years	.6

These relatives were applied, whether the person was a member of the economic family or a boarder, guest, or domestic servant. The relative factor applied to nurses for the sick was 0.9. The term equivalent adult is used in the text as representing one food expenditure unit.

It was assumed that twenty-one meals per week were eaten by each member of the economic family during that portion of the report year spent at home. For other members of the household (boarders, house guests, household help, and nurses) the actual number of meals eaten was ascertained. The average expense per meal per equivalent person was derived by dividing the total family food expense (after subtraction of expense for food eaten while traveling or on vacation) by the total number of equivalent person meals.

In order to determine the expense for meals served to boarders, the

average expense per meal per food expenditure unit was multiplied by the total number of meals served to boarders; the resulting sum was deducted from the total family expense for food at home.

Food produced at home is not taken into account in the case of the urban families, in the values presented in this paper. Food produced for home consumption is, however, taken into account in the case of farm families. Such food was valued, by the Bureau of Home Economics, at the prices farm families would have paid had they purchased similar food at the most likely place of purchase.

Table 2. Relative expenditures for food, standardized as regards income distribution.[1] (Expenditure by Family Type VI=100.)

	Type I	Type II	Type III	Type VI
Chicago	80.9	88.6	95.0	100
Middle Cities	82.8	86.8	92.7	100
Pa.-Ohio Farm	83.7	89.5	92.2	100

[1] Based on values given in Table 1.

Expenditure for food is strongly influenced by family composition. As the number of children increases, expenditures for food in specific income classes rise consistently. The relative standardized expenditures for food for the urban areas and the corresponding values for the farm area (including imputed values) for different family types are presented in Table 2.

In spite of the increased proportions allotted to food by families with children, the actual value of food consumed per food-cost unit decreases sharply as the number of children increases. Standardized expenditures (or values) per meal per equivalent adult are as follows:

	Family Type I	*Family Type II*	*Family Type III*	*Family Type VI*
Chicago	$.246	$.200	$.170	$.144
Middle Cities	$.183	$.148	$.124	$.103
Pa.-Ohio Farm	$.138	$.122	$.105	$.092

If the urban samples are broken at the $2,000 income level, the influence of family type on expenditures for food appear to be

operative with similar force at both lower and higher income groups —except apparently as regards percentage expenditures for food in the middle-sized cities. The results of this trial run as follows:

Standardized Percentage Expenditures for Food

	Family Type I	*Family Type II*	*Family Type III*	*Family Type VI*
Chicago				
Under $2,000	34.7	37.1	40.0	41.6
$2,000 and Over	26.5	30.2	32.2	34.5
Middle Cities				
Under $2,000	32.3	34.1	36.1	39.2
$2,000 and Over	24.2	24.7	27.2	28.7

Standardized Expenditures per Meal per Equivalent Adult

	Family Type I	*Family Type II*	*Family Type III*	*Family Type VI*
Chicago				
Under $2,000	$.211	$.168	$.143	$.126
$2,000 and Over	.292	.243	.205	.169
Middle Cities				
Under $2,000	.167	.137	.115	.094
$2,000 and Over	.228	.178	.148	.126

A more exact treatment of the influence of family type on expenditures for food as income rises is afforded by a comparison of curves fitted to data on total expenditures and expenditures per food-cost unit for Chicago.[8] The divergence of such curves for different family types remains fairly constant through a wide income range.

It is necessary in the case of urban families to give special consideration to the cost of food (including beverages) outside the home. Such consumption takes a larger proportion of total food expenditures among families without children than among families with children. The standardized proportions of total food ex-

[8] Unpublished study by Richard M. Graham.

penditures accounted for by food consumed away from home are as follows:

	Family Type I	*Family Type II*	*Family Type III*	*Family Type VI*
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*
Chicago	16.9	11.5	9.6	8.5
Middle Cities	9.6	5.6	5.5	4.4

It is possible that about one-half of the expenditure for food outside the home is attributable to service.[9] If we assume that this is the case, we obtain the "adjusted" expenditures per meal per equivalent adult shown in Table 3. The inter-area differences shown here are partly due to community differences in the distribution of families by income; but the inter-family-type differences are independent of this factor, since all family types within each area are

Table 3. Adjusted standardized expenditures, or values, per meal per equivalent adult.

Area	Family Type	Adjusted Expenditure or Value[1]	Relative Expenditure (Type VI = 100)
Chicago	Type I	$.225	163
	Type II	$.188	136
	Type III	$.162	117
	Type VI	$.138	100
Middle Cities	Type I	$.174	172
	Type II	$.144	143
	Type III	$.121	120
	Type VI	$.101	100
Pa.-Ohio Farm	Type I	$.138	150
	Type II	$.122	133
	Type III	$.105	114
	Type VI	$.092	100

[1] Urban values adjusted on assumption that only one-half of money spent for food outside the home is credited to "food." Farm values include imputed value of goods supplied from farm.

[9] No data are available that bear directly on this point, but see article on Restaurants in Encyclopedia of the Social Sciences for estimate of distribution of costs in restaurant management.

weighted with reference to a single standard population as regards distribution by income.

All the results obtained in this analysis are subject to several limitations. The number of cases in each sample is fairly small, and the data are necessarily imperfect. The weights used in calculating food-cost units, although based on studies of actual family food consumption and estimates of individual consumption, are rough and to some degree, arbitrary. The inclusion of expenditures for alcoholic beverages, candy, etc., introduces a luxury element which may vary widely in families of different composition and different tastes and in different income classes. Some small economies are possible in purchasing and utilizing food for larger family units. Subject to these limitations, the picture is very clear. In general, as the number of children increases, families at given income levels compromise between increased food requirements and other added needs by devoting a larger part of their available resources to food but nevertheless accepting a more restricted diet than they would otherwise be able to afford.

It is interesting to note that if all family types in each area had invested the same proportion of their total money (or total values of family living in the case of the farm families) in food, the relative expenditures per equivalent adult would have run as follows[20]:

Area	*Family Type I*	*Family Type II*	*Family Type III*	*Family Type VI*
Chicago	201	153	123	100
Middle Cities	209	165	129	100
Pa.-Ohio Farm	179	149	124	100

Taken at face value, these results would indicate that among urban families the average family with three or four children would need about twice as much income as a family without children to

[20] Dividing the relatives in Table 3 by the relatives in Table 2. *Note:* In obtaining derived values all available decimals have been used so that the results sometimes differ slightly from those obtained on the basis of the smoothed values presented elsewhere.

maintain the same plane of living, as regards food, without greater sacrifice at other points. We cannot attach much importance to these exact values, but obviously the expenditure requirements for the maintenance of similar planes of living are very different for families with no, one, two, and three or four children.

Clothing

Among Chicago families there appears to be no significant relation between number of children in the family and proportional expenditure for clothing, at given income levels. In the middle cities, families with children seem to devote a somewhat larger share of total money expenditures to clothing than do childless couples; but the difference is small. A significant relationship at this point does appear in the case of the Pennsylvania-Ohio farm families (*see* Table 1, also Appendix). In the case of clothing, separate data are available on expenditures for husbands and wives and for children. Combining the standardized proportions of total expenditure paid for clothing with proportions of this expense used for clothing of husband and wife, we obtain another index of the influence of family type on plane of living at given income levels (*see* Table 4).

It is apparent that among farm families represented in this sample, the number of children in the family has very little influence on expenditures for clothing of husband and wife. This finding can not be accepted as representative of farm families in general, because in several of the communities included in this sample dress was more or less prescribed by religious tradition. It is generally true, however, that among farm families serviceability of clothing, relative to the prestige value, is more important than among urban families. In other samples of farm families, it might be expected that the relative values of the proportional expenditures for clothing of husband and wife would be intermediate between the urban series and that for the farm families represented in this sample.

	Expenditure for Clothing of Husband and Wife as Per Cent of Total Expenditure for Clothing	Expenditure for Clothing as Per Cent of Total Money Expenditure (or Total Value of Family Living)	Expenditure for Clothing of Husband and Wife as Per Cent of Total Money Expenditure (or Total Value of Family Living)	Relative Values (Type VI = 100)
Chicago				
Type I	99.0[1]	9.0	8.9	182
Type II	80.1	8.9	7.1	145
Type III	65.5	9.0	5.9	120
Type VI	56.2	8.8	4.9	100
Middle Cities				
Type I	99.0[1]	8.5	8.4	162
Type II	78.0	9.2	7.2	138
Type III	66.2	9.2	6.1	117
Type VI	55.2	9.4	5.2	100
Pa.-Ohio Farm				
Type I	99.3[1]	5.7	5.7	136
Type II	73.0	7.0	5.1	121
Type III	63.4	8.4	5.3	126
Type VI	49.9	8.4	4.2	100

[1] Some families classed as Type I include a person other than husband and wife present in the family for a fraction of the year.

Table 4. Standardized proportional expenditures for clothing.

If the results described above were taken at face value, with an assumption of equal interest in clothing for husbands and wives in all family types, it would appear that the average urban family with three or four children would need from 60 per cent (Middle Cities series) to 80 per cent (Chicago series) more income than a family without children to maintain the same level of living in this respect. The differences appear to be much smaller in this respect among the farm families in this sample. Again, these results must be received with caution; but, taken in conjunction with those obtained by the analysis of expenditures for food, they throw some light on the pressure of increased size of family on levels of family living.

Housing and Related Expenses

No large variation among family types appears in expenditures

for housing among urban families at the same income levels, but in these figures the imputed rental value of owned homes is not taken into account. The relative importance of such imputed values does apparently differ somewhat among family types; it is highest for Type I (which may include the largest proportion of older couples) and lowest for Type II (which includes many young couples). The imputed values of housing used without direct money expense, as standardized percentages of money expenditure for housing, run as follows:

	Family Type I	*Family Type II*	*Family Type III*	*Family Type VI*
Chicago	10.1	4.9	9.0	9.0
Middle Cities	29.2	15.8	19.5	16.2

These variations are principally due to differences in the percentages of home owners among families of different types. These figures (standardized) run as follows:

	Family Type I	*Family Type II*	*Family Type III*	*Family Type VI*
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*
Chicago	16.5	9.2	16.5	17.2
Middle Cities	44.7	25.0	30.3	33.0

The proportional values of housing by family type, relative to total expenditure, are shown in Table 5, with urban values adjusted to represent total values of housing (money expenditure plus imputed value) as per cent of total money expenditure.

Except for the indication of somewhat higher values of housing available to Type I, perhaps as the result of property accumulation among the older families, there seems to be little variation among families with varying numbers of children, as regards value of housing relative to income. It is, therefore, apparent that larger families (as regards number of children under 16) are forced to

accept more crowded quarters or to live in less desirable situations than would otherwise be necessary. The influence of increased number of children does not greatly affect expenditures for housing at specific income levels; its influence on adequacy of housing relative to family needs is presumably far more serious.

Table 5. Value of housing as per cent of total money expenditure (urban), or as per cent of total value of family living (farm).

Area	Family Type			
	Type I	Type II	Type III	Type VI
Chicago	29.1	27.3	26.6	27.9
Middle Cities	32.2	28.0	27.5	27.8
Pa.-Ohio Farm	23.0	20.5	19.6	18.7

In the case of household operation, and still more in the case of furnishings and equipment, there is some evidence of the influence of increased economic strain in lowering expenditures as size of family increases.

Transportation

Expenditure for automobile is the major and most elastic factor in the transportation group. Variations in expenditures for transportation may therefore be understood as reflecting, for the most part, variations in expenses for the purchase, upkeep, and operation of autos.[11] Apparently the number of children in the family has little influence on the relative frequency of ownership of autos. Size of family does, however, appear to influence expenditures for transportation, at given income levels. There is a suggestion that expenditures for transportation (chiefly automobile) are heaviest in Type I (husband and wife only) and Type III (husband, wife, and two children under age 16). All the indices agree in pointing to the need felt by families with three or four children to get along with cheaper cars, or to purchase a new car less frequently, than families

[11] Even in cities, there is little change in expenditure for transportation other than automobile, as number of children increases. The standardized percentage expenditures for other transportation run as follows: Chicago, Type I, 2.5; Type II, 2.2; Type III, 2.1; Type VI, 1.9. Middle Cities, Type I, 0.7; Type II, 0.7; Type III, 0.7; Type VI, 0.5. The standardized percentage expenditures for automobiles run as follows: Chicago, Type I, 6.2; Type II, 4.9; Type III, 5.3; Type VI, 3.5. Middle Cities, Type I, 8.6; Type II, 7.9; Type III, 9.1; Type VI, 6.9.

	A. STANDARDIZED PERCENTAGES OF FAMILIES OWNING AUTOMOBILES, BY FAMILY TYPE			
	TYPE I	TYPE II	TYPE III	TYPE VI
Chicago	49	47	51	50
Middle Cities	61	64	65	57
Pa.-Ohio Farm	84	88	88	87
	B. EXPENDITURE FOR TRANSPORTATION AS PER CENT (STANDARDIZED) OF TOTAL MONEY EXPENDITURE OR TOTAL VALUE OF FAMILY LIVING			
	TYPE I	TYPE II	TYPE III	TYPE VI
Chicago	8.7	7.1	7.4	5.4
Middle Cities	9.3	8.6	9.8	7.4
Pa.-Ohio Farm	8.7	8.9	9.7	7.0

Table 6. Proportions of families reporting automobile ownership and proportional expenditures for transportation, by family type.

with only one or two children (*see* Table 6, also Appendix). Apparently, however, such families regard the ownership of some sort of car as sufficiently urgent to justify almost the same proportional frequency of ownership as that found among families with fewer persons to feed or clothe.

Other Expenditure Categories

Disbursements for "gifts outside the family and taxes" decrease, at given income levels, as number of children increases. This is clearly significant as a general relationship. Comparing Family Type VI with Family Type I, the reduction in this category offsets 22 per cent of the difference in expenditure for food in the Chicago sample, 31 per cent of the difference in the Middle Cities sample, and 28 per cent of the difference in value of food in the Pennsylvania-Ohio farm sample.

Expenditure for formal education in families with children under age 16 increases consistently as the number of children increases. However, these expenditures (mostly incidental or supplementary to public provisions for education) are less than 1 per

cent of total expenditures in all family types, in each area. Unfortunately, it is impossible with the data at our disposal to analyze variations in expenditure for education of older sons and daughters.

Medical care is an important, and highly variable item in family accounts. A somewhat higher proportional expenditure by urban families with one child (Type II) is indicated in Table 1, perhaps because of the frequency of payments for maternity and infant care in this group. In general, however, family expenditure for medical and dental care does not vary greatly in relation to number of children. The same is true of expenditure for reading, recreation and amusements, personal care, tobacco and other miscellaneous items. However, the sum of all these items shows a tendency to decrease, among families with children, as the number of children increases.

Savings and Deficits

Evidence regarding variations in average net change in assets or liabilities is presented in Table 7. It must be borne in mind that we are concerned here with distributions of savings and deficits at specific income levels, and with averages of proportional savings and deficits, as bearing on the financial situation of American families and not with volume of savings in relation to the national income.

Table 7. Standardized percentage of net change in assets or liabilities relative to money income (urban) or value of family living (farm), by type of family.[1]

	Type I	Type II	Type III	Type VI
Chicago	3.3	3.7	0.3	−0.2
Middle Cities	5.0	3.1	0.5	0.7
Pa.-Ohio Farm	26.4	20.8	18.5	17.3

[1] The reader is cautioned to note that these values represent averages of proportions. If average savings were related directly to average income for families of each type, the proportions would be higher due to the greater influence of savings by high-income families.

Among the farm families represented in this sample, the amounts saved or invested (largely in the farm enterprise) run very high in relation to the level of family living. The amounts saved in relation to money income earned, of course, run still higher. Among these families, there appears to be a definite trend toward decreased earnings, as number

of children under age 16 increases. Changes in assets and liabilities vary widely among farm families from area to area, and from year to year; it would be unwise to make any generalizations on the basis of data for a particular region for a single year. However, it may be that the tendency to save whenever possible, regardless of the immediate level of family living, is stimulated among farm families by participation in a speculative family enterprise, with many of the basic necessities of life drawn directly from the same source.

The standardized proportional savings of city families in these areas in 1935, even among families with no children or only one child, were very small—the relative losses of many families offsetting a large share of the relative gains of other families. Among families with two or more children the situation was even worse. Here the relative losses just about equaled the relative gains, so as to leave a precarious balance of current income and current expenditures as the general pattern.

An analysis of payments for insurance premiums indicates that investment in insurance is higher among families with children, but this may be due, in part at least, to a larger number of older couples in Type I families. There is also a suggestion that payments for insurance may reach a maximum in the case of two-child families, where the need for protection is keenly felt but where the pressure of current expenditure on income is less urgent than in the case of families with three or four children. The standardized annual payments for insurance premiums in the Chicago sample run as follows: Family Type I, $107; Family Type II, $116; Family Type III, $135; Family Type VI, $119. In the middle cities, the payments run as follows: Type I, $77; Type II, $95.60; Type III, $96.40; Type VI, $92.

Conclusion

Size of family, as regards number of children under age 16, influences the relation of expenditures to income and the distribution

of expenditures. The largest increases in expenditures, with increase of size of family at specific income levels, are found in the expenditure for food. There is very little difference in proportional expenditure for housing among the family types considered in this investigation. The excess expenditure for food by the larger families is offset by relative decreases in expenditures for various items. The most important decrease occurs in personal taxes and contributions, but this offsets less than half the excess expenditure for food. The lowering of consumption levels per consumption unit, as size of family increases, is indicated in all categories of family living. This appears in the case of food, housing, clothing, transportation, household furnishings and equipment, medical care, and recreation. As far as the available evidence goes, this influence appears to be operative through a wide range of income levels. One important category of expenditure, namely, that for education of older sons and daughters, is unfortunately not covered by this study.

The investigation indicates that no measures designed to equalize the financial resources and consumption levels of families with different numbers of children would be generally effective in meeting this objective unless applicable in some way, over a broad income range, to the major categories of family consumption such as food and housing.

Appendix

The use of rank sums follows the method described by Milton Friedman, with modifications described by A. C. Rosander. The reader is referred to their presentations for description of method and theoretical discussion.[1] The method as applied in this case, relates to the frequency with which each of the four family types ranks lowest (first), second, third or fourth in expenditure, or value, for each consumption category in given income classes. The

[1] Friedman, Milton: The Use of Ranks to Avoid the Assumption of Normality Implicit in the Analysis of Variance. *Journal of the American Statistical Association*, December, 1937, xxxii, pp. 675-701; Family Expenditures in Chicago. United States Bureau of Labor Statistics, 1935-36, pp. 243-253 (Appendix D).

distributions of rank sums for different family types are then tested (using k, a derivative of χ^2) in comparison with the probabilities of chance distribution.

This is a rigorous method, but it does not utilize all the available information because size of deviations by family type is not taken into account, but only their order, as regards size, in each income class. Unfortunately, no equally rigorous method is available that does take all information into account, and could be extensively applied with the resources available for this investigation. Moreover, the data used in this study are subject to large chance varia-

Appendix Table A. Sums of ranks of expenditures for specified consumption categories and savings by families of specified type.

Expenditure Classes	Chicago					Middle Sized Cities					Pennsylvania–Ohio Farms				
	Family Type				Distribution	Family Type				Distribution	Family Type				Distribution
	I	II	III	VI	k-test $k''=246$ $k'=169$	I	II	III	VI	k-test $k''=208$ $k'=143$	I	II	III	VI	k-test $k''=189$ $k'=130$
Food[1]	14	25	42	49	761[b]	12	22	34	42	523[b]	10	22	30	38	428[b]
Housing[2]	31	31	33	36	21	31	25	31	24	50	30	26	22	23	34
Household Operation[3]	37	36	30	29	50	30	32	27	22	51	27	27	19	28	58
Furnishings, Equipment	41	26	35	29	138	28	31	24	28	29	28	27	23	22	26
Clothing	27	30	39	35	86	16	31	28	36	206[a]	10	21	34	36	424[b]
Transportation	44	29	35	23	240[a]	26	26	31	27	17	22	24	36	19	175[a]
Gifts, Taxes	47	33	28	23	331[b]	41	25	28	17	310[b]	36	21	22	23	149[a]
Medical Care	26	42	29	34	145	24	33	26	28	49	18	27	29	26	70
Recreation, Reading	35	35	35	26	66	23	35	32	21	137	18	36	24	24	171[a]
Education	18	25	37	51	607[b]	12	25	32	42	489[b]	11	30	28	32	272[b]
Personal Care, Tobacco, Other	41	35	29	26	138[a]	29	31	31	20	77	22	26	31	23	49
Food Expense per Food Unit	52	39	25	14	821[b]	44	33	22	11	605[b]					
Insurance, Savings, Deficit	44	37	28	21	305[b]	38	26	25	21	161[a]	35	26	21	18	166[a]

[b] Values of k above k″. [a] Values of k between k′ and k″.
k″ = Value of k when probability of obtaining distribution by chance = .01.
k′ = Value of k when probability of obtaining distribution by chance = .05.
Rank sums with .5 raised in tabular presentation.
[1] Including imputed values for farm families only.
[2] Including fuel, light, electricity for urban families only.
Including imputed values for both urban and farm families.
[3] Including fuel, light, electricity and including imputed values for farm families only.

tions, due to the small number of cases in many of the cells. The absence of statistical significance should not, therefore, be interpreted as indicating the probable absence of real variations in relation to family type, with respect to the consumption categories in question, in the populations represented by these samples. In such cases, however, this analysis fails to yield any confirmation of the results otherwise obtained. The results of this application are shown in Appendix Table A. This method was also applied to data for selected occupational classes. The influence of number of children on proportional total expenditure for food and expenditure per food cost unit was significant for each of four occupational classes treated in Chicago and each of two occupational classes examined in the data for the middle cities. No distinctive differences among occupational groups in the relation of family type to consumption patterns were found, but this may be due, in part at least, to the small number of cases in each cell.

CARDIOMETRIC STUDIES ON CHILDREN[1]

II. THE DURATION OF THE COMPONENT PARTS OF THE CARDIAC SOUND CYCLE

BERT R. BOONE AND ANTONIO CIOCCO

INTRODUCTION

THE main characteristics of the heart sound patterns noted on the stethographic records of almost 1,500 children were described in the first paper of this series [Boone and Ciocco (1)]. The description given represents an attempt to synthesize the characteristics of pitch, duration, intensity, and quality, which together produce the pattern of the recorded sound waves. In addition to this synthetic view of the stethogram, and for further analysis of the records, each of these four characteristics should be examined in detail. The need for this additional analysis is evident since the auscultatory evaluation of cardiac function is largely founded on the association between pathological alterations of the heart and circulatory system, and variations in pitch, duration, intensity, and quality of the heart sounds as auditorily perceived. Of these characteristics, *duration* may be determined with the greatest relative ease on the stethogram. From the standpoint of physiology and pathology the durations of the cardiac cycle and its sound components have been considered valuable indications of the cardiac function by a number of investigators [*cf.* Lombard and Cope, 1926 (10)]. In the first place, the duration of the total cardiac cycle is an expression of heart rate and rhythm. In this respect, the relative lengths of the systolic and diastolic components in each cycle also have particular significance. In view of these facts, and as a further step toward a complete analysis of the stethogram according to the objectives outlined in the preceding paper, measurements on the duration of the cardiac cycle and its principal components have

[1] Child Hygiene Studies, Division of Public Health Methods, National Institute of Health, United States Public Health Service.

been made from the stethographic records of 1,465 children. The resulting biometric constants of these measurements are presented in this paper.

Material and Technique of Examination

The material for the first paper consisted of stethographic records on 1,482 white children attending one elementary and one junior high school in Hagerstown, Maryland. The records for seventeen children could not be used for the purposes of measurement primarily because the base lines of the graph were too rough and consequently the origin or termination of the sounds could not be clearly identified. The results presented in this paper are based, therefore, on 703 boys and 762 girls, a total of 1,465 children. The mean age of both boys and girls was 11.3 years. The children examined were in no way selected with regard to the presence or absence of heart disease; this sample, however, is not entirely representative of the general population of school children either from the standpoints of socio-economic status or of age. As discussed in the first paper, the sample contains a higher proportion of older children and of children from less well-to-do families than is expected in the general school population.

The technique followed in obtaining the stethograms has been described in detail in the first paper to which the reader is referred. Here it is pertinent to note the following main elements of the procedure:

1. The examination was conducted in a sound-insulated booth.
2. All the children were examined while in a semi-reclining position.
3. Records were made of the heart sounds at the mitral, pulmonic, and aortic areas. With reference to this item, only the tracings from the mitral area have been measured because the onsets and terminations of the sound waves appear more definite on the records taken at this area.

Method of Measuring Duration of Cardiac Cycle and Its Components

As described in the first paper and illustrated in Figure 1, the

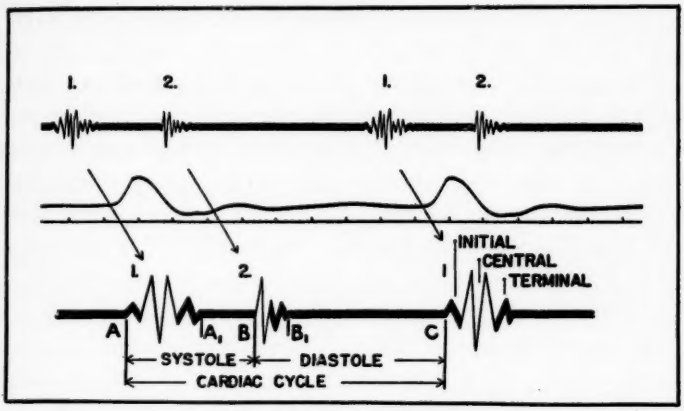


Fig. 1. Stethographic record of the basic pattern of the cardiac cycle and of its principal elements. Above is an actual tracing of two consecutive cycles and below a diagrammatic representation of the basic stethographic pattern of the cardiac cycle (AC), systole (AB), and diastole (BC). The first sound (AA_1) is indicated by 1, and the second sound (BB_1) by 2.

basic elements of the cardiac cycle are represented on the stethograph as follows:

1. A series of waves that corresponds to the first or systolic sound (AA_1, Figure 1),

2. A segment of smooth base line—the systolic interval of silence (A_1B, Figure 1),

3. A second series of waves that corresponds to the diastolic sound (BB_1, Figure 1), and

4. Another segment of smooth base line representing the diastolic interval or period of relative silence that terminates the cycle (B_1C, Figure 1).

The physiological significance of this major subdivision of the cardiac cycle is well recognized. As Lewis summarizes (9):

> The beginnings of the first and second heart sounds are used to signal the beginning and ending of the ventricular systole, respectively. When clear and sensitive records are obtained, these signals are amongst the most accurate which we possess for determining the times at which systole begins and ends; for, if they do not mark the closure, they mark

the immediately subsequent tension of the auriculo-ventricular or of the semi-lunar valves.

For purposes of the present paper, the duration of one cardiac cycle was defined as the interval of time between the initial wave of one systolic sound and the initial wave of the next systolic sound. In order to measure this duration it is first necessary to identify the systolic sound on the stethogram, and then to determine its initial deflection. The waves that constitute the systolic or first heart sound are in general distinguishable by their frequency and configuration from those of the diastolic or second sound. This is particularly true for stethographic records taken at the mitral area. Usually, the first sound is composed of three groups of waves, thus the first sound is introduced by waves of low frequency and low amplitude. The waves of the next group are of higher frequency and higher amplitude. The waves of the third group are of low amplitude but have about the same frequency as those of the second group. The diastolic or second sound is composed of two groups of waves both having approximately the same frequency but distinguishable by a difference in amplitude. It is not possible to rely exclusively on the configuration of the waves to distinguish the first and second sounds. A sure identification of these sounds can be made when in addition to the stethogram a simultaneous electrocardiogram or arteriogram is taken.

When an electrocardiogram is recorded simultaneously with the stethogram, the onset of the first heart sound takes place during the QRS complex, usually close to the peak of the R wave; the beginning of the second sound is found near the termination of the T wave. When a radial arteriogram is recorded simultaneously with the stethogram, the pulse wave is found to occur after the onset of the systolic sound and just prior to the diastolic sound. For the present study the left radial arteriogram was taken and the pulse wave was therefore utilized to identify the respective sound waves.

The onset of the waves representing a heart sound is taken to be that point where the initial wave of the group first deviates from the smooth base line. Occasionally, when some roughness of the base line is present, the onset of the initial wave may at first not be clearly evident. When some doubt arose, the use of a straight edge of opaque material was employed. The straight edge was placed parallel to and covering the base line, then moved slowly downwards until the small peaks of the roughened base line began to appear. By this procedure, the onset of the initial wave can be discerned as a definite break in the base line since the width of the initial wave is usually definitely greater than those of extraneous waves disturbing the base line. The same technique was of course employed in locating the termination of the sounds.[2]

The stethograms for this study were made on a bromide film moving at a uniform speed of 100 mm. per second. Linear measurements on the stethogram, taken in millimeters, can be converted into seconds when divided by 100. On the stethogram the measurements were taken to the last completed one-half mm. which means to the last completed .005 second. A pair of needle-pointed draftsman's dividers, a high-grade one-half millimeter rule, and a mounted reading glass lens for magnification were used for measuring. The points of the dividers were placed at the two extremes of the interval to be measured. The resulting spread of the dividers was then measured on the rule.

Although six to eight cycles were recorded at each precordial area, only one completed cycle on each individual stethogram taken at the mitral area was measured. The central or one of the two central cycles of the series was chosen for measurement.

The specific items that were measured on the cycle chosen, were

[2] If extra-vibrations follow the systolic or diastolic sound and there is an interval of smooth base line between the termination of the sound and the onset of the extra-vibration, no difficulty will be encountered in locating the ending of the sound. When, however, the extra-vibrations are continuous with the sound, then it will be observed that near the point where the termination of the sound would be expected the waves possess the least amplitude. The point of minimum deflection is taken as the termination of the sound.

the lengths of the total cardiac cycle, the lengths of systole and diastole, and the lengths of the first and second sounds.

Duration of the Cardiac Cycle and of Its Principal Components

The mean, median, standard deviation, and coefficient of variation of the duration of the cardiac cycle, systole, diastole, first and second sounds, respectively, computed from the measurements made on the stethographic records of the 1,465 children are presented in Table 1.

From this table the following facts appear noteworthy:

1. The mean duration of the cardiac cycle equals .722 seconds. This represents an average heart rate for this sample of children of 83 beats per minute.

2. The duration of diastole as measured here is one and one-half times as long as that of systole. The duration of the first sound is about one and one-half times that of the second.

3. The values of the median approximate very closely to those of the mean indicating that the frequency distributions of these durations are on the whole symmetrical.

4. The variability of the distributions, when measured by the standard deviation, is highest for the cardiac cycle. Of the components of the cardiac cycle discussed here, the largest standard deviation is found for the duration of diastole and the smallest for the duration of the second sound. However, the relative variability (coefficient of variation) is

Table 1. Biometric constants of the duration of the cardiac cycle, systole, diastole, first and second sounds measured on the stethograms of 1,465 children.

Sound Cycle Unit	Constants of the Frequency Distribution of Duration			
	Mean	Median	Standard Deviation	Coefficient of Variation
Total Cycle	.722 ± .0025	.721 ± .0031	.140 ± .0017	19.39 ± .25
Systole	.289 ± .0005	.291 ± .0006	.027 ± .0003	9.34 ± .12
Diastole	.433 ± .0020	.428 ± .0025	.113 ± .0014	26.10 ± .35
First Sound	.108 ± .0005	.105 ± .0006	.026 ± .0003	24.07 ± .31
Second Sound	.070 ± .0003	.069 ± .0004	.018 ± .0002	25.71 ± .33

least for the duration of the systole and highest for the duration of the diastole. It is also to be noted that the coefficients of variation obtained for the duration of the first sound and the second sound differ very little from the coefficient computed from the frequency distribution of duration of diastole.

The findings outlined in the last item deserve particular emphasis. In this sample, the differences among children relative to systole are much less marked than the differences relative to diastole or to the first and second sounds. Furthermore, since the first sound is a constituent of systole, from these observations it is to be inferred that the duration of the systolic interval (the interval between the end of the first sound and the onset of the second) is actually the most stable of the components of the cardiac cycle.

Following the first successful attempt made in 1892 by Hürthle [*cf.* Hürthle, 1895 (6)] to obtain permanent and objective records of heart sounds, the measurement of the duration of the cardiac cycle and that of its major components has been repeatedly the object of many investigations conducted by physiologists. The results obtained by the majority have been well summarized by Tigerstedt, [1921 (15)], Schütz [1933 (13)], and Oriás and Braun-Menéndez [1939 (11)]. A comparative study of the reported measurements reveals striking differences among the several series. In part this is probably due to differences in methods and techniques of recording the sound vibrations since at least ten, if not more, types of instruments have been constructed and utilized for the purpose. In part, the variation in the reported average measurements is due to the small number of observations on which they are based. Usually the data reported derive from measurements made on records of very few subjects, frequently only one or two persons. The duration of the cardiac cycle is found to vary from .628 seconds as reported by Ohm [*cf.* Tigerstedt, 1921 (15)] to 1.034 observed by Gerhartz [1910 (5)]. The duration of systole has been reported as low as .208 seconds also by Ohm and as high as .40 seconds by

Einthoven [1907 (3)]. The reported durations of the first and of the second sounds also vary considerably. Roos [1908 (12)] gave the duration of the first sound equal to .041 seconds, while the figure given by Einthoven [1907 (3)] is .176 seconds; the shortest second sound, equal to .024, was observed in the series of observations made by Gerhartz [1910 (5)] while the longest, equal to .104, by Einthoven [1907 (3)]. In view of the fact that these are observations based not on a series of records but on one or two individuals, and considering the value of the standard deviations in Table 1, the range reported could be due to chance. However, the method of recording and other factors such as age and sex must obviously play an important part in the duration of these cardiac events. This is seen when the data of Table 1 are compared with those of Table 2 which contains the results obtained by those investigators who measured the records of ten or more individuals. The comparison of the means of Table 1 with the data of Table 2 brings out the fact that the results obtained in the investigation reported here are somewhat lower than those reported by others, particularly by Lombard and Cope who have utilized the most extensive information to date.

The significance of differences in the examination is strikingly shown in Lombard and Cope's figures that indicate the effects of the standing, sitting, and recumbent positions on the duration of cardiac cycle, systole, and diastole. The duration of these cardiac phenomena is least when the subject is standing and greatest when the subject is recumbent. In addition, these same data point to a definite sex difference in the duration of the cardiac cycle, systole, and diastole, these all being longer in the males than in the females. It is to be noted also that with the exception of Bridgman's figures (2), the data concern adults. For systole, diastole, and cardiac cycle Bridgman's averages resulting from observations made on sixteen boys, 12-15 years old, are lower than Lombard and Cope's and Eyster's (4) but very close to those reported in the present paper.

Investigator	Total Cycle	Systole	Diastole	First Sound	Second Sound	Number of Observations
Eyster (1912)	.854	.307	.557	.128	.101	16 Adults, Average of 50 Cycles
Kapff (1914)	....	....	....	.08	.06	11 Adults
Bridgman (1915)	.731	.314	.417	.145	.089	16 Boys, Average of 10 Cycles
Kanner (1921)	....	....	....	.16	.10	10 Adults
Lombard and Cope (1926)	.7324	.2341	.4983	....	....	252 Tests, 176 Men, Average 15 Cycles Standing
	.8156	.2677	.5479	....	....	94 Tests, 91 Men, Average 15 Cycles Sitting
	.9453	.3003	.6450	....	....	64 Tests, 64 Men, Average 15 Cycles Recumbent
	.6932	.2467	.4485	....	....	72 Tests, 68 Women, Average 15 Cycles Standing
	.7477	.2693	.4784	....	....	58 Tests, 58 Women, Average 15 Cycles Sitting
	.8057	.3003	.5054	....	....	58 Tests, 58 Women, Average 15 Cycles Recumbent

Table 2. Mean duration of cardiac cycle, systole, diastole, first and second sounds reported by several investigators.

From these comparisons it appears that the duration of the cardiac phenomena discussed here are affected by a number of physiological factors unconnected with health or disease. Consequently before full use can be made of such data for purposes of detecting the cardiac status of children or of adults it is necessary to investigate further what factors other than pathological affect the durations of these cardiac phenomena. Even though the technique of examination relative to position, respiration, etc., of the subject is standardized as has been done in the present investigation, it still remains to arrive at a measure of the influence of other conditions, particularly of the age and sex, on the duration of the cardiac cycle and that of its components. These will be considered in the following sections.

Duration of Cardiac Cycle and of Its Major Components in Boys and Girls

Between males and females definite differences are manifest in relation to the mortality and probably to the morbidity from diseases of the heart and circulatory system. At all ages, the males exhibit a higher mortality from cardiovascular diseases except from chronic endocarditis which in certain age periods is more prevalent in the females. Differences between the sexes are observed also relative to the stethographic pattern of the heart sounds. As reported in the previous paper, variations from the basic pattern are found more often in boys than in girls. The one exception is the presence of a third heart sound noted more frequently in the girls.

Besides the differences mentioned it is a well-established fact that the pulse rate in the females is more rapid than in the males. It is to be expected, therefore, that the duration of the cardiac cycle, because of its reciprocal relation to rate, should be longer in the boys than in the girls of this sample. These expectations are borne

Table 3. Biometric constants of the duration of the cardiac cycle, systole, diastole, first and second sounds measured on the stethograms of 703 boys and 762 girls.

Sound Cycle Unit		Constants of the Frequency Distribution of Duration			
		Mean	Median	Standard Deviation	Coefficient of Variation
Total Cycle	Boys	.746 ± .0034	.748 ± .0043	.135 ± .0024	18.10 ± .36
	Girls	.699 ± .0031	.697 ± .0039	.127 ± .0022	18.17 ± .33
Systole	Boys	.292 ± .0007	.293 ± .0008	.026 ± .0005	8.90 ± .16
	Girls	.287 ± .0007	.288 ± .0009	.028 ± .0005	9.76 ± .17
Diastole	Boys	.454 ± .0030	.456 ± .0038	.117 ± .0021	25.77 ± .49
	Girls	.412 ± .0026	.405 ± .0033	.107 ± .0019	25.97 ± .48
First Sound	Boys	.112 ± .0007	.108 ± .0009	.027 ± .0005	24.16 ± .46
	Girls	.105 ± .0006	.102 ± .0007	.024 ± .0004	22.86 ± .41
Second Sound	Boys	.070 ± .0005	.069 ± .0006	.018 ± .0003	25.71 ± .49
	Girls	.069 ± .0004	.068 ± .0006	.018 ± .0003	26.09 ± .47

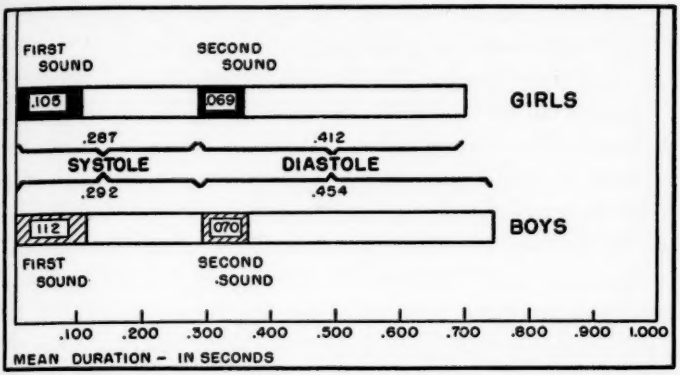


Fig. 2. Mean durations (in seconds) of the cardiac cycle, systole, diastole, first and second sounds obtained from measurements taken on the stethograms of 703 boys and 762 girls.

out by the observations presented in Table 3 and illustrated in Figure 2.

From both the figure and table it is apparent that the mean duration of the cardiac cycle and of each of the components studied is longer in the males than in the females. The mean duration of the cardiac cycle of the boys is .047 seconds longer than that of the girls. In terms of heart rate, this difference amounts to 5 beats per minute. The greater duration of the cardiac cycle in the boys being over ten times its probable error is statistically significant. This is likewise true for the other components of the cardiac cycle, the only exceptions being the duration of the second sound.

With regard to the median durations, the differences between the sexes are of the same order and directions as those of the arithmetic means.

The absolute variability of the distributions for the two sexes when measured by the standard deviations is not consistently greater or less for either sex, although the boys are more variable with regard to duration of cardiac cycle, diastole, and first sound. However, because the arithmetic means are all smaller in the case of the

girls, the latter exhibit for almost all the measurements an insignificantly higher relative variability (coefficient of variation).

Lombard and Cope (*cf.* Table 2) have reported sex differences for adults in the mean duration of the total cardiac cycle, systole, and diastole. These investigators also indicate that systole, relative to duration of cardiac cycle, is longer in women than in men. The data of the present study indicate the same. It will be noted that while for the boys the mean duration of the cardiac cycle is 6 per cent longer, the mean duration of systole is only 2 per cent greater. In addition, the mean duration of the first sound is found to be slightly over 6 per cent longer in the boys while that of the second sound is only 1 per cent longer in the boys than in the girls.

Summing up, then, these data show definitely that the duration of the cardiac cycle and its principal components is greater in the boys than in the girls. However it can be inferred that in terms of duration of the cardiac cycle, the duration of systole and of the second sound is somewhat greater in the girls.

Duration of the Cardiac Cycle and of Its Principal Components in Relation to Age

The sex differences reported in the preceding section are present at each year of age in this sample of children. This is evident from the data on the mean duration of the cardiac cycle and of its components illustrated in Figure 3.

In Figure 3 it will be noticed that at each year of age, excepting 11 years, the duration of the cardiac cycle of the boys is longer than that of the girls. At 11 years of age, the mean cardiac cycle of the girls is .003 seconds longer than that of the boys. At this same age, the girls also exhibit a longer mean diastole by .005 seconds but at all other ages the diastole of the boys is longer on the average. The values for the mean duration of systole, first and second sounds are also higher in the boys in the majority of cases. Thus, it seems that the differences between the boys and girls are, on the whole, consistent at all ages, from childhood through adulthood. What signifi-

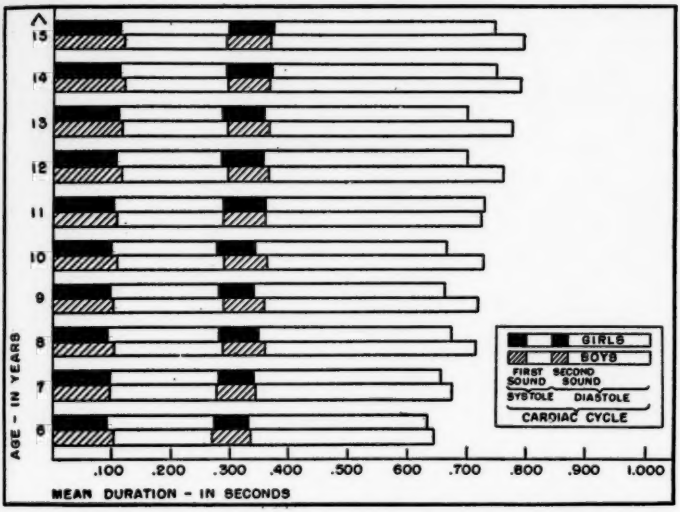


Fig. 3. Mean durations (in seconds) of the cardiac cycle, systole, diastole, first and second sounds obtained from measurements taken on the stethograms of 703 boys and 762 girls of stated age.

cance these differences may have relative to the sex differences in mortality and morbidity from heart diseases is not known. Yet these and other findings regarding the diverse pattern of behavior of the two sexes with respect to disease point to the direction which will lead to an understanding of some of the elements responsible for the breakdown of the cardiovascular system.

The data presented in Figure 3 also indicate that with advancing age, the expected increase in the duration of the cardiac cycle results from an increase in the duration of all the components discussed here. This is more clearly seen in Figure 4 in which the mean values at each age for both girls and boys together have been plotted on an arith-log grid. From Figure 4 it appears that between the ages of 6 and 15 years the mean duration of each of the cardiac events measured here increases annually at a rate which is almost uniform from year to year.

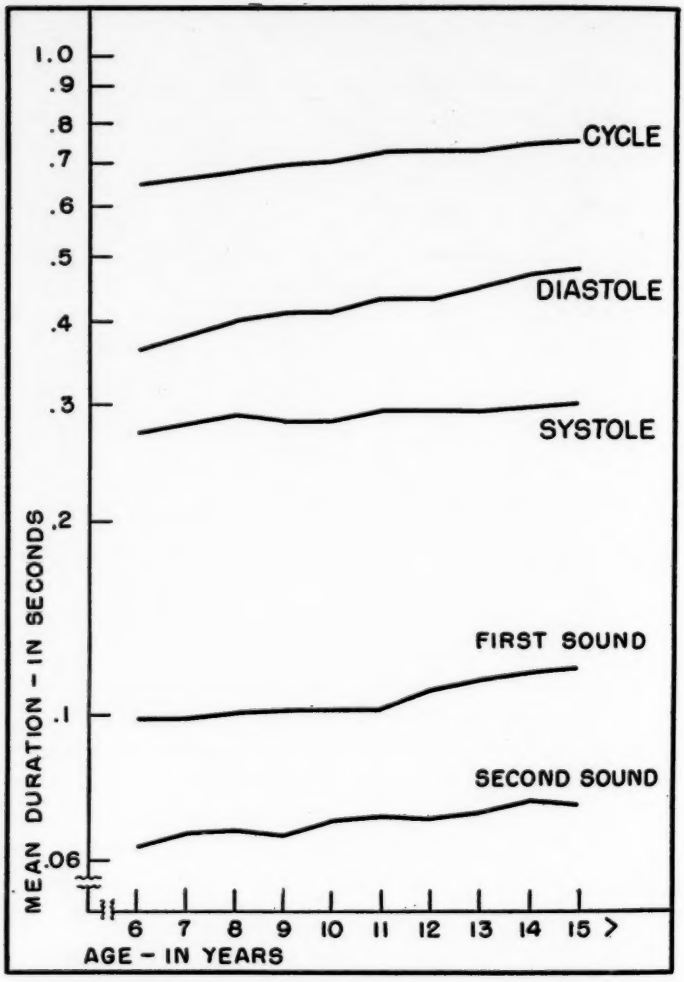


Fig. 4. The age trend of the mean durations of the components of the cardiac cycle plotted on arith-log. scale. The measurements have been obtained from the stethograms of 1,465 children.

Since the values of the arithmetic means are plotted on a semi-

logarithmic graph their slopes are directly comparable. An examination of the age trends reveals that apparently the rate with which diastole lengthens in duration as age increases is more rapid than that of the systole. The duration of systole also increases more slowly than that of the cardiac cycle. On the other hand, both the first and the second sounds apparently increase at a rate almost the same as that of the diastole. It seems then that with advancing age, the increase in the duration of the cycle results from an increase in the length of both systole and diastole, but the major portion of the increment is due to the lengthening of diastole. This together with the other facts presented in the present paper show that the duration of diastole is more variable than that of systole and therefore variation in the total duration of cycle, the summation of systole and diastole, results to a greater degree from the variation of diastole.

Although the duration of the cycle increases at practically a uniform rate between the ages of 6 and 15 years, it is to be realized that this is a short range of years and the rate observed holds good only within this range. It is a known fact that on the average the pulse rate decreases sharply from a high rate of about 130 beats per minute [*cf.* Vierordt, 1893 (16), also Sutliff and Holt, 1925 (14)] in infancy to one of about 105 at 3-4 years of age. It continues to decline until the rate of 72 is reached at 20 years of age. Thereafter the average rate of 72 is maintained with little change, throughout the remainder of life. The steady decline of the pulse rate from childhood to adulthood would lead to the expectation of the trend observed in the duration of the cardiac cycle (*cf.* Figure 4).

Furthermore, if the observations made on the present sample of children are expressed in terms of heart beats per minute (heart rate=60/ cycle duration) the age trend will be found to parallel that reported for pulse rate. In Figure 5 is illustrated a comparison of the average heart rate observed in these children with Sutliff and Holt's mechanical perequation of the average pulse rates measured under basal conditions and reported by a number of in-

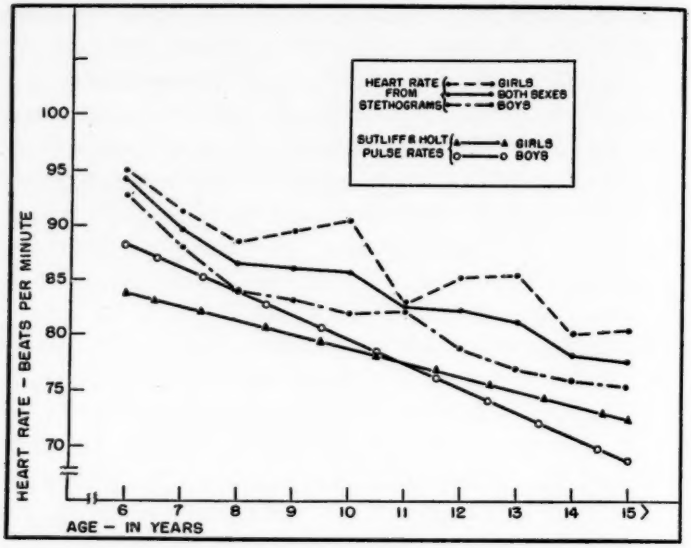


Fig. 5. Average heart rates obtained from the stethographic records (rate = $\frac{60}{\text{cycle length}}$) of 703 boys and 762 girls of stated age compared to the average pulse rates reported by Sutliff and Holt.

vestigators. From Figure 5 it appears that the average heart rates derived from the stethographic records are about 5 beats higher than the average pulse rates reported by Sutliff and Holt. Whether the higher rate found in this sample is due to the differences in the method of measuring or to the differences in the physical condition of the children of the two samples cannot be determined. It is interesting to note that in contrast to older data [*cf.* Vierordt, 1893 (16)] on pulse rate, Sutliff and Holt arrive at a higher rate for boys than for girls below the age of 11 years. The main point of the comparison of the two sets of data is, however, the age trend and in this there is remarkable agreement. Combining boys and girls it is found that Sutliff and Holt's data indicate an average decrease in pulse rate of 1.5 beats per minute for each year of age while the heart

rate of the present sample decreases by 1.6 beats per minute on the average between the age of 6 and 15 years.

Summary

This paper describes the technique employed in measuring the duration of cardiac cycle, systole, diastole, first and second sounds from the stethographic records of 1,465 children. A statistical analysis of these measurements reveals:

1. For all the children the mean duration of the total cycle is .722 seconds which corresponds to a heart rate of 83 beats per minute. The mean duration of diastole equals .433 seconds and is about one and one-half times longer than the systole whose duration is .289 seconds. The mean duration of the first sound is .108 seconds while that of the second sound is .070 seconds.

2. The standard deviation of the frequency distribution of cycle duration is .140 seconds or 19 per cent of the mean. Therefore, within the area of the distribution curve limited by one standard deviation above and below the mean, a range containing roughly two-thirds of the children, the heart varies from 64 to 102 beats per minute.

3. Of the major components of the cardiac cycle, the duration of diastole is the most variable in absolute terms. The duration of the second sound is the least variable. However, relative to the mean value, the duration of systole differs the least from child to child while that of diastole varies the most.

4. The mean durations of the cardiac cycle, systole, diastole, first and second sounds are all longer in the boys than in the girls and this sex difference is to be observed generally at all ages.

5. The mean durations of the cardiac cycle and its components increase at a uniform rate from age 6 to 15 years. It is to be noted that the rate of increase is apparently not the same for systole and diastole; the former increases at a slower rate than the latter.

6. A comparison of the age trend of the stethographic heart rates

with data on pulse rates compiled by others reveals that during the age period under discussion the average annual rate of decrease is almost identical in the series compared.

The main objective of these cardiometric studies, as has been stated, is to arrive at a means of developing an objective "screening device" to select children who require special attention or care with respect to the heart and circulatory system. The analysis reported in the present paper has for its purpose to give a description of the stethographic pattern of the heart sounds in terms of their duration. From the data reported tentative standards can be set up for the evaluation of the cardiac status of children, but the results of repeated tests on the same children and of other clinical and laboratory examinations must be studied in connection with the present data before it is possible to determine definitely the significance of individual deviations from the values of duration obtained.

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RHEUMATIC FEVER

FACTORS IN ITS OCCURRENCE[1, 2]

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IT IS the purpose of this paper to mention and discuss the circumstances under which rheumatic fever seems to flourish. The justification for doing this lies in the fact that we are still in the stage of exploration in so far as methods for the control of this disease are concerned. There are no public health procedures at our disposal which can be regarded as effective preventive measures as yet, and in the absence of such measures one of the next best things that can be done is to examine the conditions under which rheumatic fever is most frequent on the one hand; and to compare them with conditions under which it is most infrequent on the other. For, if it can be found that the disease flourishes under conditions that can be altered or improved, this fact in itself might indicate that there is something preventable about the disease which has not as yet been tried.

First, as to its geographical distribution. With few exceptions it is agreed that rheumatic fever is a disease of temperate climates and that it is rare in tropical or subtropical regions. It is very common in New York City. From 1 to 2 per cent of the school children in this general area have been found to have rheumatic heart disease. It is apparently less common in Florida, and it is uncommon in southern Arizona. A measurement made in the western part of this country has shown that rheumatic heart disease is ten times more frequent among children living near the Canadian border than among those living near the Mexican border. This fact probably has something to do with the living conditions in the north and

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south, and the way people are crowded within doors during northern winters. However, it is not, necessarily, a fact that can be readily utilized for therapeutic purposes, or even for purposes of prevention except perhaps in the case of the fairly well-to-do, for the practical use of climate in this disease has not been worked out yet. Certainly we are not ready for the wholesale exodus of our rheumatic children to warmer climates. Eventually climatic treatment may find its place among the list of things which are important to do for the care of patients with rheumatic heart disease, but at present one should proceed cautiously before recommending its use.

Secondly, rheumatic fever is known to be a familial disease. It runs in families—definitely. That does not mean that it is *essentially* hereditary, and in spite of a good deal of work on this subject one can hardly improve upon the statement made by Cheadle fifty years ago, that, "The tendency to rheumatism is transmitted. . . ." In other words it does not mean that everything about it is hereditary. Other things run in some families besides inherited traits, such as, for instance, scabies and lice. But whatever the significance of its family prevalence is, it is of great interest to anyone concerned with the control of this disease to know that if one parent has or has had rheumatic fever, the chances of their children acquiring it are about 10 to 30 per cent; whereas if both parents have had it, the chances are much higher. This fact alone makes it evident that any control program in this disease should really center upon the family, and in doing this we are again following a lead already established by workers with the other two major chronic infectious diseases which beset our civilization in this part of the world, namely, tuberculosis and syphilis. They too, are family diseases, although a good deal more is known about them than is known about rheumatic fever. But in all three diseases the family approach remains as an opening wedge in the field of prevention. Private physicians, hospitals, and dispensaries will probably accomplish more in the way of prevention by taking advantage of this fact, than by any other means now

at our disposal. The mechanism for dealing with the rheumatic family has not been standardized, but if one child, or even one parent in a family, is found to have the active disease it is fair to assume that the conditions which favor the presence of this illness (whether they are *hereditary* or *environmental*) are present in that household; and the least that one can do is to begin by examining the other members of the family.

And next, and quite important, is the fact that rheumatic fever is a city disease and a crowd disease, although it does not seem to be evenly distributed through some city populations. It is, apparently, a disease of urban, middle classes. Most pediatricians practicing in the city or its suburbs will tell you that rheumatic fever patients are uncommon in their private practices in comparison to the relative number seen in the hospital wards. But from the work done in New Haven on this subject one cannot say that its prevalence follows poverty directly. It is true that our school surveys have shown rheumatic heart disease to be eight times as prevalent in children from schools in the poorest districts of the city as among children who attended private schools, but this does not mean that it is absent among the well-to-do, because that is not the case at all.

From a number of district surveys which have been made in nine areas in New Haven we have learned something about this fact.[4] These surveys of small areas have been carried out over a period of six years and the methods used have been described in an earlier number of this *Quarterly*.[5] Briefly it will suffice to say that we have gone from house to house in these districts in an effort to dig out the story of rheumatic fever, and the evidences of heart disease among every inhabitant in the district, which usually amounted to about 100 or more people. The districts were representative of the worst and of the best living conditions in the City of New Haven;

[4] These surveys have been aided by grants from the Milbank Memorial Fund.

[5] Paul, J. R.: Methods of Determining the Prevalence of Rheumatic Fever in Cities and Small Communities. The Milbank Memorial Fund *Quarterly*, January, 1935, xiii, No. 1, p. 52.

some were damp and some were dry. The study is not quite finished but there are a few things to report already. Again we can say that the prevalence of rheumatic fever did not seem to be directly related to the quality of the living conditions. We found the greatest concentration of cases in one single district among what might be called a middle-class group living in damp surroundings. We did not find eighteen cases in three houses, as was reported from Germany during the past century, but we did find that sixteen cases of rheumatic fever and rheumatic heart disease had occurred among the children of thirty-two families which lived in this district, which is at the rate of one case of rheumatic fever to every other family. It would seem that it is to such areas as these that our attention should begin to be directed, namely, to concentrated foci of the disease, whether they occur in families, or houses, or districts. At least I am sure that a tenement house full of cases of rheumatic fever offers as much promise for clinical investigation today as does a ward full of rheumatic patients.

And finally as to the actual bacterial cause of this disease. The question is too complex for discussion here but it is safe to say that *hemolytic streptococci* have something to do with the cause of rheumatic fever. This causal relationship can be shown from the manner in which an epidemic of rheumatic fever follows close upon the heels of an epidemic of streptococcus infection. It can be shown from immunological tests too. Obviously, therefore, whatever the conditions are which promote the spread of hemolytic streptococcus infections, they should be numbered also among the environmental factors which have something to do with rheumatic fever. Such conditions probably include crowding and "poor" hygienic surroundings, and, in the state of our present knowledge, that is about all one can say.

But certainly the hemolytic streptococcus does not tell the whole story. It is the nature of susceptibility to infection by this organism which remains the greatest single question in this disease. Why is it

that one child with tonsillitis of hemolytic streptococcus origin has a short disease with no sequellae whereas another develops rheumatic fever following his attack of tonsillitis? This is one of the main problems which demands solution. It is conceivable that there may even be two or more infections or types of illness which combine to give the clinical picture. Perhaps we have a situation like that of tuberculosis in which a "bad influence" upon the human host, such as that of exposure to silica dust, rouses a latent case of tuberculosis into activity.

But the final point to be made is this: we cannot cure rheumatic fever with serums or with medicines, although it is possible that something may be done in the field of prevention by the careful and prolonged use of sulfanilamide, as proposed by Coburn[6]—a procedure which is still in the experimental stage. We cannot give those rheumatics who are peculiarly susceptible (either through their inheritance or environment) a new body or a new heart. But occasionally one can improve the environment for the rheumatic child. And I would like to make one suggestion, which is, that efforts to do this be considered from the point of view of the whole family as well as to the individual patient with the disease. Rheumatic fever is, I will reiterate, a familial infection, and as such it lends itself peculiarly well to this sort of a household approach. What effect some of the housing programs may have upon rheumatic families is one of the features which may give us some interesting information on this point in the course of the next few years.

[6] Coburn, A. F. and Moore, L. V.: Prophylactic Use of Sulfanilamide in Streptococcal Respiratory Infections, with Especial Reference to Rheumatic Fever. *Journal of Clinical Investigation*, January, 1939, xviii, No. 1, p. 147.

STUDIES OF RHEUMATIC DISEASE[1]

III. FAMILIAL ASSOCIATION AND AGGREGATION IN RHEUMATIC DISEASE

ROSS L. GAULD AND FRANCES E. M. READ[2]

AT THE present time the available evidence is insufficient to establish definitely the etiology of rheumatic disease although promising work has been done and is in progress. It has long been recognized that there is a tendency for the disease to occur more frequently in some families than in others. In a previous study (1) based upon the records of the families of patients admitted to the Cardiac Clinic of the Harriet Lane Home, careful statistical analysis suggested that hereditary constitution might be a factor in causing this aggregation. The evidence presented, however, did not exclude the possibility that the familial aggregation might be due solely or principally to common exposure either to a microbic cause and/or to any environmental factor, such as nutritional deficiency, which favored development of the disease.

If the disease were due solely to heredity, it would be expected that it would manifest itself in the various members of the family in such a way that its first acute manifestations (onsets) would be scattered along the time scale of family experience in a random fashion or affected solely by the age of its members. On the other hand, if in addition to hereditary predisposition, an environmental factor or factors were concerned, it would be expected that during certain periods of time in the family experience the risk of attack would vary according to the degree with which the environmental factor was acting. Thus we would expect a certain amount of group-

[1] Reprinted from *The Journal of Clinical Investigation*, March, 1940, xix, No. 2, pp. 393-398.

[2] From the Cardiac Clinic of the Harriet Lane Home (Department of Pediatrics) of the Johns Hopkins Hospital in cooperation with Child Hygiene Investigations of the United States Public Health Service and the Department of Epidemiology, Johns Hopkins University, School of Hygiene and Public Health, Baltimore.

Acknowledgment is made by the authors to Dr. Kenneth Maxcy, Dr. Lowell J. Reed, and Miss Jean Downes for their assistance and advice in the preparation of this article.

ing of the onsets of new cases occurring in the family, and after one member had developed acute manifestations of the disease there would be an increased incidence among his familial associates. This expectation would be justified regardless of the environmental factor involved, whether it be an infective agent and/or some other common environmental factor necessary for the development of the disease. In other words, a tendency toward the grouping or aggregation of new cases within the family would appear at certain times, as in the case of infective disease such as diphtheria, scarlet fever, tuberculosis, and in nutritional deficiencies like pellagra.

To elucidate this relationship, the records of the group of families previously used in the study of the hereditary factors have been analyzed to determine the relationship of the first appearance of rheumatic manifestations[3] (onsets) in the various members of these families along a time axis.

Material and Methods

The data upon which this report is based have been extracted from the medical records of ninety-six consecutive admissions of white children to the Cardiac Clinic of the Harriet Lane Home because they were suffering from rheumatic disease, and from the epidemiological record of this disease in their parents and siblings. A manifestation of rheumatic disease was defined as chorea, rheumatic fever, or rheumatic heart disease, and this definition is the same as that used in the two preceding articles (1, 2). Detailed information for each individual in ninety-five[4] of these families is available with respect to the date of birth, date of last observation, and the date of onset, duration, and type of each manifestation of rheumatic disease. The data relative to the rheumatic manifestations have, in most instances, been confirmed by hospital records. The relationship between the acute manifestations of rheumatic disease

[3] This analysis deals only with the time relationship of primary onsets; second and subsequent attacks in any member have been considered as recurrences.

[4] One family in which the records are incomplete has been excluded from the study.

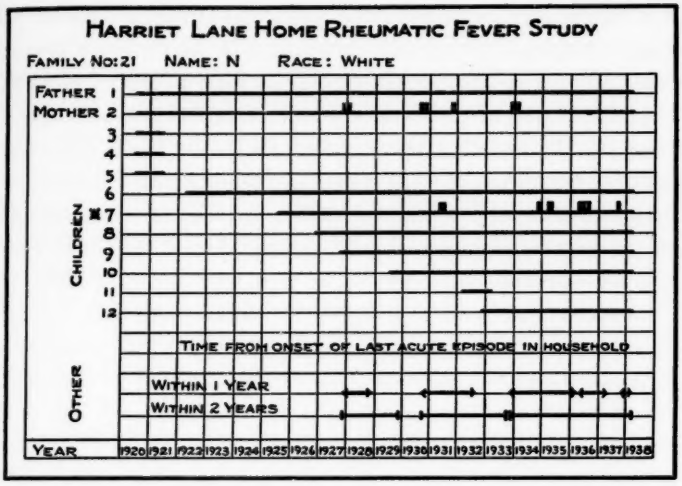

Fig. 1. FAMILY GRAPH. Solid line indicates life-experience in the household. Acute episodes are indicated by solid blocks on top of line.

in the various members of each family, and the age of each individual when exposed to these attacks, can be ascertained from these reports. As an aid in this analysis, family graphs were drawn for each family showing the intrafamilial relationship of all attacks of rheumatic disease. A sample graph is shown in Figure 1.

In order to hold the factor of heredity constant, as far as possible, the families were divided according to whether or not their parents had a history of rheumatic disease. There were forty-three families in the group in which one or both parents were rheumatic, and fifty-two families in which neither parent had a rheumatic history. The *children* of these families have been studied to determine if an increased risk of developing the disease was associated with the occurrence of an acute episode of the disease in any other member of the household (adult or child).

It should be noted that the ninety-five families under study were selected because at least one member (a child) was admitted to the

clinic suffering from rheumatic disease. The children who are responsible for the inclusion of their families in the study are known as "index cases" to distinguish them from their siblings who enter the study because of their familial relationship. The index case is not necessarily the first case to occur in the family, but it is the first to come to the clinic suffering from the disease. Because index cases are the means through which the families are selected and, by definition, must have had an attack of rheumatic disease, they have been excluded from the tabulations in order to avoid bias and attention has been confined to the occurrence of the disease in their siblings who are unselected, except with regard to their familial relationship.

The final composition of the group studied was:

	Number of Families	*Number of Siblings of Index Cases*
Rheumatic Disease in Parents	43	156
No Rheumatic Disease in Parents	52	191

The life-experience of these siblings, in each of the above groups, has been divided into that which preceded familial association[5] with another member of the household (adult or child, including index cases) suffering from an acute manifestation (primary or recurrence) and that which followed such association. By this procedure it is possible to compare the incidence of new cases in the children during these two periods.

The occurrence of rheumatic disease in the children of these families could be expressed as the percentage who had the onset of their first attack before, as compared to after, association with an acute episode, but such a statement is not fully satisfactory because it fails to take into consideration the time during which each was at risk during these periods and the possible differences in age sus-

[5] The word association is preferred because the terms "exposure" or "contact" would imply that the effective environmental factor is opportunity for transmission of an infective agent. For present purposes it is desirable to avoid this assumption.

ceptibility. For this reason, the experience of these children has been recorded in the terms commonly applied in the general population to express incidence of any disease, namely, the age-specific annual rates of morbidity.

In order to state the observations on this group in these terms it is necessary to reduce the prior and subsequent experience to a comparable base. This can be done by expressing the experience of these children in person-years of life before and after the date of the first intrafamilial association with an acute episode of the disease. By this method consideration can be given not only to the number of children in the family group, but also the length of time and the various ages during which each child was under observation.

If the purpose is to calculate morbidity prior to familial association with an acute attack, the age at which observation begins is at birth, because all of these children entered their respective families at birth. The age at which observation ends is dependent upon the occurrence of the first of four possible events: (*1*) death, (2) familial association with an acute attack in another member of the family, (*3*) onset of rheumatic disease, and (*4*) termination of observation without association. If the purpose is to show morbidity subsequent to association the observation begins with the age attained when first associated with an acute attack and ends with either (*1*) death, (2) onset of rheumatic disease, or (*3*) termination of observation. The actual procedure necessary to convert the observations into person-years of experience is that described by Frost (3) and Stewart, Gass, Gauld, and Puffer (4) in their studies on tuberculosis.

Incidence of Rheumatic Disease in the Children of the Families of Rheumatic Index Cases, Prior and Subsequent to Exposure to Acute Rheumatic Manifestations in any Member of the Household

The experience of the children in the study group expressed in person-years, along with the cases of rheumatic disease, and the

Age	Prior to Association with an Acute Episode			Subsequent to Association with an Acute Episode		
	Person-Years	Cases	Rate per 100	Person-Years	Cases	Rate per 100
	NO PARENTAL HISTORY OF RHEUMATIC DISEASE					
Under 2	338.5			20.50		
2-4	425.5			62.50	2	3.20
5-14	706.5	10	1.41	336.00	9	2.68
15+	89.5	2	2.23	121.75	2	1.64
Total Over 2 Years	1,221.5	12	0.98	520.25	13	2.50
	PARENTAL HISTORY OF RHEUMATIC DISEASE					
Under 2	243.0			48.50		
2-4	257.0	4	1.55	128.25	3	2.34
5-14	305.0	6	1.96	397.50	18	4.53
15+	17.0			99.00	4	4.04
Total Over 2 Years	579.0	10	1.73	624.75	25	4.00

Table 1. Life-experience, cases of rheumatic disease, and annual attack rates among the siblings of ninety-five rheumatic index cases, prior and subsequent to first association with an acute manifestation of the disease, and according to the history of rheumatic disease in the parents.

annual morbidity rates are shown in Table 1. In this table the children are grouped according to the history of rheumatic disease in their parents, and the experience divided into that which preceded and that which followed first association with an acute episode.

In calculating the total incidence of rheumatic disease for these two periods, only the experience of the children after their second birthday has been used. This has been done because the occurrence of rheumatic manifestations under two years of age is rare, and no cases occurred during this age period in these families.*

When the annual rates for all ages over two years are compared, before and after association, it is found that the incidence in both groups of children is more than doubled in the period following

* The effect of this deduction from the total life-experience has been to minimize the differences found between the incidence in the two periods.

association with an acute episode in the household. In those children whose parents gave no history of rheumatic disease, the rate increased from 0.98 to 2.50 per 100 per year, while in those whose parents had a history of rheumatic disease the increase was from 1.73 to 4.00. Although based upon a comparatively small experience, these differences are sufficiently large to have statistical significance; the probability of a difference of this size occurring by chance in this group is only two in one hundred trials.

It should be further noted that, although the experience in each age group is not large enough to give statistical significance to the differences, with one exception the age-specific rates are consistently higher after familial association with the acute disease.

From the data in Table 1 it is also possible to compare the incidence in children of rheumatic and nonrheumatic parents. This comparison may be expressed in a ratio as follows:

Ratio of Incidence

$$\frac{\textit{Children of Rheumatic Parents}}{\textit{Children of Nonrheumatic Parents}} \times 100$$

Prior to Association with an Acute Episode	$\frac{176}{100}$
Subsequent to Association with an Acute Episode	$\frac{160}{100}$

It is interesting to note that the incidence is 60 to 80 per cent higher in the children of rheumatic parents than in the children of nonrheumatic parents, and that this ratio is not materially altered by association with an acute manifestation of the disease.

The Time Relationship Between Association and the Onset of New Cases Occurring Subsequently

The analysis up to this point has dealt with the total incidence of new cases of rheumatic disease among siblings of index cases which preceded and followed the *first* familial association with an acute

episode. This fails to take into consideration the fact that a child might be associated with more than one acute episode in other members of the family before showing clinical evidence of having contracted it. If the occurrence of an acute episode in one member of the family is an indication that an environmental factor or factors, which have etiological significance, are operating at this particular time, then it would be expected that during the time interval closely following this event the risk of attack would be increased for other members in the same family. This in turn would be reflected in an increased case rate during a proximal subsequent period as compared with later periods.

Table 2. Time interval between last prior association with an acute episode in another member of the family and the onset of rheumatic disease in thirty-eight cases.

Interval	Number of Cases
Less Than 1 Year	15
1-2 Years	8
2-3 Years	5
3-4 Years	1
4-5 Years	5
5-9 Years	2
Over 10 Years	2
TOTAL	38

In Table 2 is shown the distribution of thirty-eight cases which occurred among the siblings of index cases according to interval elapsing between the time of association with the last prior acute episode and the time of onset.

It will be noted that fifteen of the thirty-eight cases had their onset within one year, and twenty-three (15 + 8) within two years of their last prior association with an acute episode in another member of the family. At first glance the distribution suggests that the risk is greatest among these children within a year or two following association with an acute attack. This tabulation, however, does not show the number of cases in proportion to the number of persons still under observation in the stated intervals and, accordingly, does not indicate the relative risk in these periods.

Using the onset of each separate acute episode as a focal point,

Time from Last Association with an Acute Episode	Person-Years Experience	Cases Onset During Period	Rate per 100 Person-Year
	PARENTS—NO HISTORY OF RHEUMATIC DISEASE		
Less Than 1 Year	257.50	7	2.7
1 to 2 Years	120.75	4	3.3
More Than 2 Years	142.00	2	1.4
	PARENTS—HISTORY OF RHEUMATIC DISEASE		
Less Than 1 Year	312.25	8	2.5
1 to 2 Years	130.50	4	3.1
More Than 2 Years	182.00	13	7.1

Table 3. Showing the incidence of rheumatic disease subsequent to first association with an acute manifestation according to its proximity in time to acute attacks in other members of the family.

it has been possible to divide the total experience of each child, subsequent to first association, according to its proximity to the onset of the last acute attack in another member of the family. This division was made in three time bands: (*1*) the experience which fell within one year following association with an acute episode, (*2*) that which was more than one year and less than two years following association, and (*3*) that which was more than two years following association.[7]

After the total experience following first association of each child was divided in this way, that of the group as a whole was obtained by adding the individual experiences together. Rates can be calculated for each interval by dividing the cases having their onset within it by the corresponding total person-years experience. These rates express the annual incidence of the disease in those at risk according to the proximity to *all* acute episodes with which the children were associated.

Although the experience is small, it shows no tendency for new cases appearing in other members of the family to be grouped or

[7] In making this division, the procedure was to calculate for each individual the amount of experience following first association which was within one year and that which was

(Continued on page 170)

aggregated closely about the time at which one member comes down with acute manifestations. Indeed, if any inference at all is

within two years of association with an acute episode in the household. The detail for calculations on Individual 6, Family 21 (shown graphically in Figure 1), was:

Beginning of Association		End of Period		Episodes with Which Associated		Number of Months in Period
Date	Age	Date	Age	Date of Onset	Individual Attacked	
		A. EXPERIENCE WITHIN ONE YEAR OF BEGINNING OF ASSOCIATION WITH AN ACUTE EPISODE				
December, 1927	5	December, 1928	6	December, 1927	No. 2	12
September, 1930	8	November, 1932	10	September, 1930	No. 2	
				June, 1931	No. 7	
				November, 1931	No. 2	26
December, 1933	11	April, 1936	14	December, 1933	No. 2	
				December, 1934	No. 7	
				April, 1935	No. 7	29
May, 1936	14	May, 1937	15	May, 1936	No. 7	12
October, 1937	15	February, 1938	15	October, 1937	No. 7	5
						84
		B. EXPERIENCE WITHIN TWO YEARS OF BEGINNING OF ASSOCIATION WITH AN ACUTE EPISODE				
December, 1927	5	December, 1929	7	December, 1927	No. 2	24
September, 1930	8	November, 1933	11	September, 1930	No. 2	
				June, 1931	No. 7	
				November, 1931	No. 2	38
December, 1933	11	February, 1938	15	December, 1933	No. 2	
				December, 1934	No. 7	
				April, 1935	No. 7	
				May, 1936	No. 7	
				October, 1937	No. 7	51
						113
		C. TOTAL EXPERIENCE SUBSEQUENT TO FIRST ASSOCIATION WITH AN ACUTE EPISODE				
December, 1927	5	February, 1938	15		No. 2 and No. 7	123

Final allocation of experience:

Experience within one year of association (A) $\frac{84}{12} = 7$ person-years.

Experience more than one and less than two years following association (B-A) $\frac{113-84}{12} = 2\text{-}5/12$ person-years.

Experience more than two years following association (C-B) $\frac{123-113}{12} = \frac{10}{12}$ person-years.

permissible, it is the contrary one, *i.e.*, that after the disease has occurred in one member of the family it may be a matter of years rather than of months before another member is attacked.

Summary and Discussion

The children of ninety-five families, in each of which one child entered the clinic because of some rheumatic manifestation, were studied with respect to the relationship of the occurrence of the disease among them to familial association with an acute episode of the disease in another member of the family. As far as possible hereditary factors were held constant throughout the analysis, and the index cases were excluded from the tabulations because of the bias which they introduced.

The analysis showed that the risk of contracting the disease among the siblings of the index cases was increased, following association with an acute episode in another member of the family, to more than twice that which prevailed prior to this association. This suggests that there is an environmental factor which plays a rôle in the causation of this disease.

The children of rheumatic parents had higher attack rates than the children of nonrheumatic parents, both before and after their first familial association with an acute episode. The interpretation of this finding should be made with caution because the children who have parents with a rheumatic history are, in most instances, also associated with what might be called the chronic quiescent phase of the disease in these parents. The higher incidence in these children could, therefore, be due either to an increased hereditary susceptibility or to long continued association with the disease in chronic form. Considered along with the findings of the previous article (1), the first would seem to be the more probable explanation, *i.e.*, that heredity plays a definite rôle in the etiology of the disease.

The time relation between episodes in the family and the occur-

rence of subsequent cases in other members did not show a definite tendency for the incidence of subsequent attacks to be highest within short time intervals of an association with acute episodes. This finding would suggest that either long continued exposure to the cause (whether it be parasitic or nonparasitic) is necessary, or that the disease is slow in developing to the point where it becomes clinically manifest. In this respect, if it be due to an infection, it therefore resembles tuberculosis rather than an acute infection such as scarlet fever or diphtheria, and the results of exposure in any household should not be measured in weeks or months but in years.

These findings are consistent with the hypothesis that in the etiology of rheumatic disease there are both hereditary and environmental factors involved, and that the environmental factor to produce the disease must act over a long period of time, and/or the disease has a long period of subclinical development before becoming manifest. They are consistent with such an hypothesis, but do not prove it, because other explanations could fit the observed facts.

Conclusions

Careful observations over varying periods of time on 347 siblings of ninety-five children who were admitted to the clinic because of some rheumatic manifestations showed that the attack rate:

1. Increased after association with an acute episode.
2. Was higher among the children of rheumatic parents both before and after such association.
3. Showed no tendency, following association with an acute episode, to be higher within a short proximal period as compared with a more remote later period.

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ANNOTATIONS

PEOPLE: THE QUANTITY AND QUALITY OF POPULATION[1]

PROFESSOR FAIRCHILD, in his book, entitled PEOPLE, has obviously written with the intent of making available to the general public some of the interesting findings of students of population. In this attempt, he is very successful, for by means of a wide variety of entertaining illustrations drawn from both plant and animal kingdoms, he develops the thesis that all population problems arise from the conflict of two forces, "hunger" and "love." Extending this principle to mankind, he discusses the work of Malthus and other early students of human population problems, and then proceeds to a clear and interesting presentation of some of the more modern work. In this connection he discusses the growth of population in relationship to birth rates, death rates, changes in the age composition of the population, true rate of natural increase, and available resources. While the author is skillful in introducing his reader to this material, there are times when he uses illustrative anecdote, quotation, and analogy in such profusion that the reader will have a tendency to lose sight of the thesis that is being developed at the moment.

As the book proceeds, it becomes clear that the author is not merely attempting a popular presentation of our present knowledge as to the factors involved in the population problem, but that he is concerned with the improvement of society through eugenics as "a sociological, not a biological, enterprise." This part of the book is not so successful. His treatment of "the optimum population" seems to show that in any given state of social organization some optimum does exist, but his discussion as to what this optimum is drifts off into a treatment of birth and death rates, both crude and specific. Similarly, under the heading "quality of popu-

[1] Fairchild, Henry Pratt: PEOPLE: THE QUANTITY AND QUALITY OF POPULATION. New York, Henry Holt and Company, 1939, 315 pp. $3.00.

lation" the author shows that we need and desire "better people" but that the definition of "better" is practically impossible and in general rests on emotional grounds.

The book urges positive control of population growth to prevent overpopulation, and ends with the idea: "It would seem to need no argument to show that the modern, the scientific, the human way is to fix upon some standards of social well-being, to discover a formula of population growth conducive to those standards, and then to regulate the actual reproduction of the community accordingly." Since the author does not favor the control of human reproduction by a super-eugenicist, it becomes clear that such a plan could only be carried out on a democratic basis, that is, by individual action; and in this connection he adds: "Reflections such as these may help the intelligent individual, or married couple, to chart out a socially acceptable line of personal behavior in the matter of reproduction. Only the genuinely intelligent person, in the present state of scientific knowledge and social conventions, can possibly chart a sound program, and only a person with highly developed self-control and firmness can carry it out. Only one with a sensitive social conscience will even want to chart such a course or try to carry it out." To the extent to which the book transforms its readers to members of this class, it will be a success.

LOWELL J. REED

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NEW YORK STATE PROGRAM FOR CANCER CONTROL

IN MAKING cancer and other malignant tumors reportable diseases, New York State has taken a step forward. According to Dr. Edward S. Godfrey, Commissioner of Health of the State of New York,[1] reporting should in the course of time make available to the medical profession accurate information instead of uncertain estimates on:

1. The true magnitude of the cancer problem.

2. The relative incidence of cancer in the various sections of the State and among various social and economic groups.

[1] Godfrey, Edward S.: New York State Program for Cancer Control. *New York State Journal of Medicine*, December 15, 1939, No. 24, pp. 2280-2283.

3. The relation between cancer and such factors as occupation.

4. The extent of the alleged increase in cancer above that due to the aging of the population.

5. The accuracy of mortality statistics.

6. The true incidence of the various forms of cancer.

Undoubtedly reporting of cancer should contribute to a more accurate conception concerning the prevalence of the disease. Prevalence is intimately related to the incidence and fatality of the disease and such information is necessary for wise and adequate planning of facilities for care and treatment of cancer patients.

The expanded program for control of cancer in New York State is to include: the establishment of tumor clinics at strategic points throughout the State, cancer institutes to be held in various cities through the cooperation of the state and county medical societies, and studies of the economic aspect of the cancer problem.

Among 8,000 cancer patients admitted to various hospitals and clinics in the State, there was during a four- to five-year period a case-fatality of 82 per cent. Assuming that the case-fatality in this group holds true for the general cancer population, on the basis of results achieved with patients adequately treated at an early stage of the disease, Dr. Godfrey has estimated that the fatality of the disease could be reduced to 60 per cent which would mean in up-state New York a saving of 2,300 lives each year. On this basis for the entire nation there would be a saving of 38,000 lives annually.

In a discussion of the unfavorable side of the mortality record for 1939 among the Industrial Policyholders of the Metropolitan Life Insurance Company, the following comments concerning cancer are pertinent:

> All in all, the record for cancer gives little comfort. The achievement in this field is in sharp contrast with what has been accomplished with diseases like typhoid fever, the communicable diseases of childhood, tuberculosis, diarrheal diseases of infancy, and conditions arising out of pregnancy and childbirth. No substantial progress has been made in the control of this condition, and today, in the United States, it is the recorded cause of one out of every nine deaths. No marked improvement

will be noted, we believe, until provision is made for the discovery of cases early and for their skilled care.[2]

Cancer is indeed one of the most fatal diseases; it now ranks third among the leading causes of death. Cancer also carries with it the burden of invalidism. The problem of its control challenges the best efforts of physicians and public health officials.

JEAN DOWNES

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ACCEPTED FOODS AND THEIR NUTRITIONAL SIGNIFICANCE[1]

IN ALMOST every issue of *The Journal of the American Medical Association* appear reports of the action of the Council on Foods on food products whether acceptance, rejection, or rescindment of previous acceptance. It is not to be expected that the reader will retain in his memory this unending, running record.

The book, ACCEPTED FOODS AND THEIR NUTRITIONAL SIGNIFICANCE, retraces the positive side of the record. Here, some 3,800 brands of food products, accepted as of September 1, 1939, are brought together, classified, and indexed for ready reference. One useful feature is that the nutritional significance of the various types of foods is comprehensively discussed. We suspect that physicians and many health workers, particularly nurses, are being asked more and more about the value of particular foods; those not altogether fluently conversant in this specialty, but who desire a reading knowledge of it, would find comfort in this book.

But there are twenty-nine pages which alone constitute the outstanding section of the work. They should be read not only by every physician but by every literate layman. These pages relate the history of the Council, and describe its purpose, policy, methods, and scope: how with very limited powers it acts on a voluntary basis as a regulatory body to protect the public; how it carries authority and exerts influence by force of its prestige and the merit of its mission; and how its self-appointed task is to

[2] New Low Record For Mortality in 1939. *Statistical Bulletin,* Metropolitan Life Insurance Company, January, 1940, 21, No. 1.

[1] ACCEPTED FOODS AND THEIR NUTRITIONAL SIGNIFICANCE, *by* Council on Foods of the American Medical Association. Chicago, American Medical Association, 1939, 492 pp. $2.00.

prevent exaggerations and misrepresentations by false claims in advertising which not only violate ethics but play on inexhaustible human gullibility to the detriment of health.

The Council's method of keeping advertising in line is to put the premium of its approval on accuracy and honesty. We have no way of knowing how widely the public is guided in its food purchases by the Council's seal of acceptance. But the colossal number of food brands bearing the stamp is a gratifying testimonial not only to the essential integrity of the food industry but to the effectiveness of the Council's services.

H. D. KRUSE, M.D.

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MOTHERS OF THE SOUTH

WITH the rapid decline in urban birth rates, the attention of students of sociology has been centered on the agricultural areas with high birth rates from which a large proportion of the future population of the country is being recruited. The poverty of the farm areas where birth rates are highest has led to some concern for the quality of the population in these areas. A few writers have expressed the fear that poor areas may be the source of poor stock, and that as urban stocks are replaced by the surplus population of these areas, the quality of the whole population will decline.

Margaret Jarman Hagood, research associate in the Institute for Research in Social Science at the University of North Carolina, has recently made a study of farm tenant women which affords a new understanding of some of the qualitative characteristics of the tenant population of the cotton and tobacco farms of the southeast.[1] Following a statistical investigation of the population differentials in the southeast,[2] Mrs. Hagood made repeated friendly visits to a sample of 129 women in the Piedmont

[1] Hagood, Margaret Jarman: MOTHERS OF THE SOUTH: Portraiture of the White Tenant Farm Woman. Chapel Hill, University of North Carolina Press, 1939. 252 pp.

[2] Hagood, Margaret Jarman: MOTHERS OF THE SOUTH: A Population Study of Native White Women of Childbearing Age in the Southeast. Unpublished doctoral dissertation, University of North Carolina, 1937.

area of North Carolina. With each mother she discussed in detail the problems of the home and the farm. The result of the visits is a revealing book about southern tenant farm mothers.

Mrs. Hagood discusses in terms of case histories the tenant woman as field worker, housekeeper, wife, community member, and mother. The reader cannot but be impressed with the character of women who, with large families of children to feed and rear,[8] must find time for field work as well as for cooking, laundering, sewing, and housecleaning; who are striving to give their children more educational opportunities than they themselves have had, and at the same time to rear them with high moral standards. Perhaps their methods of child-rearing would not meet with the approval of modern educators, but the reader cannot fail to appreciate the stamina and ambition of these farm women who, in spite of ruinous poverty, malnutrition, lack of medical care, and inadequate educational facilities, are making a brave fight for what they believe to be a better life for their children.

Mrs. Hagood stresses the need of assistance in medical care, economic security, and educational opportunities to help these mothers overcome almost insuperable obstacles. If her farm women are typical of the group from which they come—and the author appears to have been careful in her sampling techniques—there need be little fear for the innate quality of the southern farm tenants but there must be a real effort to improve their environment through wise agricultural policies and increased facilities for health, recreation, and education.

REGINE K. STIX, M.D.

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DEVELOPMENT OF TUBERCULOSIS IN INFECTED CHILDREN

"IS A primary infection with tuberculosis acquired during childhood a relative safeguard against subsequent exposure? Or does the sensitization acquired through such infection result in increased susceptibility to progressive disease?" These questions, which are of great importance to the public health administrator, have been raised by Dr. Alton S.

[8] "The mean number of children borne per woman is 6.3 but . . over two-thirds of the children are in families where there are seven or more children." Hagood, 1939, p. 109.

Pope, *et al*, in an article, "Development of Tuberculosis in Infected Children."[1] As recently as 1937, Frost, in a discussion of the control of tuberculosis, said: "We do not yet know enough about the nature and durability of any immunity which may be conferred by infection acquired in childhood."[2] Pope points out that these questions can be answered, at least in part, by careful observation over a sufficient period of time of two population groups, namely, children who at the beginning of observation had tuberculous infection, and those who did not give evidence of infection. The basic material presented in this paper consists of data on some 400,000 school children tuberculin-tested in the Chadwick Clinics conducted by the Massachusetts Department of Public Health during the period 1924-1934, the re-examination of certain groups of these children, and the cases of tuberculosis and their mortality reported in the entire group to the end of 1936.

Among the infected children (reactors to the tuberculin test of von Pirquet) the attack rate from adult type of tuberculosis in subsequent years was 189 per 100,000 population, which was four times the rate of 43 per 100,000 noted among the nonreactors. The death rate from tuberculosis was three times as great among the reactors and the case fatality was essentially the same in the two groups.

A selected group of some 19,000 children with roentgenological signs of primary infection or a history of contact who were re-examined annually was the subject of special study. During a period of eleven years of observation, 6 per cent of these children developed adult pulmonary tuberculosis.[3] Also, in this group, children with a history of exposure to tuberculosis in the family had an attack rate from the disease two and a half times that among children without known exposure.

Age-specific morbidity rates for ages 6 to 19 indicated that adult pulmonary tuberculosis in school children is infrequent below the age of ten. The incidence rises rapidly after age ten, and much more rapidly in girls than in boys.

A significant comment made by Pope concerning the results of this study is as follows: "All of our evidence indicates that in school children

[1] Pope, Alton S.; Sartwell, P. E.; and Zacks, David: Development of Tuberculosis in Infected Children. *American Journal of Public Health*, December, 1939, 29, No. 12.

[2] Frost, Wade H.: How Much Control of Tuberculosis? *American Journal of Public Health*, August, 1937, 27, No. 8, p. 759.

[3] The average age of these children at the beginning of observation was 11 years, and the average number of years observed was 3.4.

it is the *age* of the individual rather than the time of exposure or any environmental factor which determines the time at which tuberculosis develops." This finding is in general agreement with a conclusion drawn from Frost's study of tuberculosis mortality in successive cohorts.[4] His conclusion was: "Constancy of age-selection (relative mortality at successive ages) in successive cohorts suggests rather constant physiological changes in resistance (with age) as the controlling factor."

This study of Pope's offers further evidence of the need for special public health supervision of infected children during the period of adolescence when resistance to tuberculosis is ostensibly lowered. It is apparent from the data presented that relatively close clinic supervision does not prevent the development of adult pulmonary tuberculosis in infected children. Therefore, some additional measures of control or prevention which can be applied at the ages when resistance is lowest must be sought.

JEAN DOWNES

[4] Frost, Wade H.: The Age Selection of Mortality from Tuberculosis in Successive Decades. *The American Journal of Hygiene*, November, 1939, xxx, No. 3, Section A, pp. 91-96.